The Dock & Harbour Authority

No. 452. Vol. XXXIX. JUNE, 1958 Monthly 2s. 6d.

The Dock & Harbour Authority

An International Journal with a circulation extending to 85 Maritime Countries

No. 452

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JUNE, 1958

Monthly 2s. 6d.

Editorial Notes

Opening of Sinclair Wharf, Belfast

In the presence of Lord Wakehurst, Governor of Northern Ireland, and a distinguished company of guests, Her Majesty Queen Elizabeth, the Queen Mother, last month formally opened and named the Sinclair Wharf and Transit Shed on the Herdman Channel, Belfast.

Readers of this journal will recall that in our special issue for July 1957, we included an article on post-war developments at the Port of Belfast, in which we mentioned briefly the considerable developments in hand for the Sinclair and Stormont wharves. Built at a cost of approximately £1 million, the Sinclair Wharf and Shed are part of a £4½ million improvement scheme planned by the Harbour Commissioners to keep pace with the increasing industrialisation of Northern Ireland.

In her speech, the Queen Mother said that the rapid turnround of ships could be achieved only by the building of adequate wharves and sheds and harbours capable of dealing with large tonnage. She was therefore very pleased to learn that the Harbour Commissioners had embarked on a long-term programme of development, the first stage of which had been completed with the opening of the new Sinclair facilities.

The new wharf is 1,241-ft. in length with a depth of 30-ft. at ordinary low water and 38-ft. 6-in. at high water, which means in effect that the largest cargo ships in the world will be able to berth there. The shed adjacent to the wharf is 1,100-ft. long and 120-ft. wide, and is said to be the largest single-span structure of its kind in the United Kingdom. It has storage space for some 10,000 tons of general cargo.

When it is considered that the Sinclair Wharf and Shed are only the first stage in the development scheme, and that very shortly a second deep-water wharf, the 650-ft. long Stormont Wharf will be ready for use, one is impressed by the vigour and foresight of the Commission. Work is also proceeding on the widening of the Victoria Channel and proposals are well in hand to deepen the Musgrave and Herdman Channels. These improvements indicate the confidence of the Harbour Commissioners, not only in the future of Belfast as a port, but in the future of Northern Ireland as an industrial centre of the Commonwealth, and we take this opportunity to wish them continued success.

United Kingdom Ports and Shift Working

The employment of the shift system in port operating work was advocated by speakers at the annual conference of the Institution of Traffic Administration in October last, when discussion took place on factors influencing traffic through British ports. Indeed, since the end of the 1939—45 war, shift work has been discussed in ports all over the world. In some countries, the question has been an academic one; in others, something real—and this fact offers an important clue to its answer.

Where a nation has enjoyed full employment, shift working has not always been popular in any industry—nor, indeed, has it always been practicable. Certain maritime countries established the shift system in their ports as they were recuperating after the war and, where it has been retained, it has made the port more attractive.

There have been many pleas in this country for shift work "to replace the present inertia that descends on many ports during the major part of each 24 hours"—but there has not been much action. An article on a following page of this issue refers to the advantages of the system but at the same time emphasises the difficulties of introducing it into the United Kingdom ports, leaving the reader to doubt whether the author is one of its advocates.

In our view, certain major ports in the United Kingdom could not cope with shift work without long-term preparations. Essential requirements would often include more road and rail transport and improved connections and, in ports like London, a bigger fleet of barges. In all ports, in order to keep transit accommodation "fluid," it would be necessary for the receiving and despatch of goods to continue by night as well as by day.

Besides road, rail and water transport, the interests involved include shipping, forwarding, receiving, warehousing, engineering, power supplies, police, customs, catering and, of course, stevedoring and cargo superintending. Some, at least, of these interests would have to organise themselves on a 24-hour working day basis.

The implications of introducing a shift-work system into a major port are long term and far reaching. It is obvious therefore that much detailed study and negotiation would be necessary before a satisfactory solution to this problem could be found.

The National Dock Labour Scheme

As the Eleventh Annual Report of the National Dock Labour Board became available, the port of London was suffering from another unofficial strike. Nearly 20,000 men had stopped work and many ships were idle, causing the exasperated Port Employers in London to issue the following statement:—

"We are anxious that the serious effect of unofficial and so-called sympathetic strikes on the trade of London and on the interests of the community in general, should be more fully appreciated by the public and that the intolerable burden imposed on those directly concerned with carrying the responsibility for maintaining the flow of goods should be better realised."

After reviewing the history of the strike, which began when dockers in riverside centres withdrew their labour to support an unofficial strike of meat transport drivers, the statement went on: "Two points clearly emerge. First, that from the very beginning there has been no question of any industrial dispute between the

Editorial Notes—continued

dockers and the port employers—except, of course, that the employers have the grievance that the men have withdrawn their labour unconstitutionally and in breach of all their agreements. Secondly, that the employers have displayed great patience and have co-operacted in every way with the Union officials in endeavours to get the men back."

This strike cannot be dissociated from the operation of the National Dock Labour Scheme. The Board's Annual Report is clear and comprehensive. It is full of analyses and comparisons, facts and figures, some of which are given in a review of the Report on page 59 of this issue. One fact stated is that the number of man-days lost by disputes during 1957—viz. 94,077—does not compare unfavourably with that of most of the years since the Scheme's inception. The major part of the time lost was due to support being given in London to the strike of Covent Garden porters.

It is pertinent at this point to mention that the most important finding of the last committee appointed to look into the operation of the Dock Labour Scheme (the Devlin Committee, 1956) was that "None of the grave unrest that has occurred can be put down to any provision of the Scheme that has turned out to be unworkable." Perhaps a distinction should be made between "grave unrest" and "irresponsible action" but both have such a serious effect on the industry that it seems academic to make it. When a loss, due to unofficial strikes, of 94,077 man-days in a year does not compare unfavourably with the normal, surely something must be wrong with the working of the Scheme.

One important part which needs redesigning is its disciplinary machinery, which is expected to work satisfactorily although lacking the normal employer-employee relationship. It is so slow, cumbersome and generally unsatisfactory in fact, that many employers do not even use it. Since, with individuals, it is hardly effective at all—except in the most serious cases—the men in the mass have come to disregard it. They will stop work unofficially at a moment's notice, knowing they can sign on again at will. Another weakness is that, in participating in the Management of the Scheme, the Unions' Officials must often be faced with seriously conflicting responsibilities. On the one hand they have to watch the interests of their members and on the other they have to take part in the Board's decisions, so that when disputes occur, their loyalties are divided. The lack of discipline which the operation of the Scheme in its present form permits, often adds to their difficulty in performing either function satisfactorily.

Agreement with Belgium on Terneuzen-Ghent Canal

The Netherlands Minister for Transport and Waterways last month announced—in a written reply to a parliamentary question—that full agreement has been reached between the Dutch and Belgian Governments on the projected improvement of the canal between Ghent and Terneuzen.

The agreement covers the proportion of costs of the work to be done on Dutch territory, the nature and approximate measurements of sea and inland shipping locks at Terneuzen, the increase in the width and depth of the canal, transport and traffic connections between the embankments, road links, the regulation of salt percentages in the canal water, and seaport, rail fares and harbour dues.

The project is to widen and deepen the canal for the use of ships up to 690-ft. in length with a draught up to 36-ft.

Both governments want the earliest possible realisation of the plan, and it is hoped that work will begin early in 1960.

International Standardisation Conference

For the first time in Great Britain, the triennial assembly of the International Organisation for Standardisation (I.S.O.) is being held at Harrogate from June 9—21. Delegates are attending from every one of the 40 member countries, and comprise industrial leaders, engineers, scientists and other specialists.

The work of the I.S.O. in evolving international standards is carried out by over 80 specialised technical committees and fifteen of these are meeting during the conference. One of these is working on the drawing up of world standards on the sizes of pallets, while the newest of them is trying to draft out world standards for the safe and efficient design and operation of nuclear reactors, and for the protection of workers from radiation, and also to compose a glossary of nuclear terms in the I.S.O's three official languages.

Industrial standards, which state how materials and products should be made, measured, tested or described, are increasingly used to stimulate productivity and it is therefore important that, in the export trade, the standards of one country should not be in conflict with those of its customers or suppliers in another. Where such standards do conflict, they tend to form as great a barrier to trade as tariffs. Since the International Standardisation Organisation came into being at the end of the last war, it has published some sixty "recommendations" which can be incorporated in the national standards of its member countries, and many more are in an advanced stage of preparation.

The programme for the Conference also includes visits by delegates to factories and other places of industrial interest in the area. There will also be a Government reception for the visitors and a banquet, which will be attended by many leaders of British industry who have a special interest in standards work.

Radar System for the Elbe and Weser

Details of a radar navigation project, in the approaches to the Elbe and Weser estuaries were announced recently. The first steps towards increasing the safety of shipping in that area were taken by the West German Federal Government in 1953, when the Netherlands Radar Research Establishment at Noordwijk was invited to assist in an advisory capacity and to place test installations at the disposal of the federal authorities. Experiments led to the conclusion that 3 cm. radars should be provided for the sea areas fronting the river mouths and that some of them should be installed in lighthouses.

The radar signals picked up by these stations will be conveyed by radar links to two central stations where they will be displayed on separate plan position indicators. The radar equipment will be remotely controlled from the central stations so that operators can be concentrated at these two points.

As in the Rotterdam New Waterway radar chain, each station will be equipped with two sets of transmitting and receiving apparatus, so that continuous operation is ensured.

The systems will employ an entirely new type of Philips display unit using transistors. The aerials, based on a design developed by the Netherlands Radar Research Establishment, are also new. The use of a slotted radiator, shaped like the wings of an aircraft, make the aerials unusually light and therefore very suitable for mounting on lighthouses. The two systems are expected to go into operation at the end of 1960.

Annual Report of Canadian National Harbours Board

The 22nd annual report of the Canadian National Harbours Board, Ottawa, which was presented to the Canadian Parliament recently, showed that the total earned from harbour operations in 1957 was $23,304,000. This figure was $754,000 or 3 per cent. lower than the gross operating income for 1956.

The net operating income for 1957 was $9,033,000 and the net income surplus $1,325,000, compared with $9,691,000 and $2,304,000, respectively, in the previous year. Traffic statistics indicated an overall decrease of 7.5 per cent. in waterborne cargo tonnage at the national ports in 1957, compared with 1956. Capital expenditure amounted to $18,495,000.

A number of important new facilities were completed and put into operation, and contracts were let for others upon which some $23,000,000 is yet to be expended. In addition, $3,597,000 was spent on the maintenance of existing facilities. The major construction projects completed or in progress during the year included new or improved wharves at Halifax, Quebec, Montreal, Churchill and Vancouver, and new transit sheds at Halifax, Saint John, Three Rivers and Montreal. Several improvements were made to the grain elevator systems at Halifax, Montreal and Vancouver. At Montreal the south shore approaches to the Jacques Cartier Bridge were raised to provide clearance for vessels that will be using the Seaway, and the construction of piers and placement of fill for the Nun's Island Bridge was begun.

The Port of Belfast

Progress of Current Development Programme

(Specially Contributed)

As part of their overall scheme for the continued development of the Port of Belfast, the Harbour Commissioners decided to increase the deep water accommodation of the port by adding three wharves; (1) the Sinclair Wharf on the East side of Herdman Channel, (2) an extension to the existing Herdman Channel Wharf on the West side and (3) Stormont Wharf on the West side of Victoria Channel. The latter is equipped with a 200-ton Cantilever crane and all wharves have transit shed accommodation.

Sinclair Wharf (See Fig. 1)

This wharf is 1,240-ft. long, providing a depth of 30-ft. at Ordinary Low Water with provision for eventual deepening to 35-ft. The wharf is constructed with a flat reinforced concrete slab supported on a piled foundation, the site being on land reclaimed about 75 years ago.

The strata generally consist of about 30-ft. of a fine estuarine silt, locally termed "sleetch," overlying 10—15-ft. of fine red and grey sand, before a bed of stiff red clay is reached. Red sandstone underlies the clay at depths varying from 92-60-ft. below ground level.

Test piles indicated a satisfactory foundation at the Northern end of the site, but at the South end pile lengths of up to 90-ft. appeared to be required. Experiments were made to reduce this length by forming blisters on the piles, thus virtually increasing the pile size. This enabled a pile length of about 56-ft. to be used eventually.

At this site the berth was formed by dredging away the bank after the wharf was built. Trial designs showed that for this condition the cheapest was one in which the retaining wall is at the front of the wharf. This method largely eliminates the effect of the surcharge behind the wharf, the standard for this being 5 cwt/sq. ft. in Belfast. The width of the deck slab also allows the ground level to be sloped underneath, thus reducing the height of the retaining wall and allowing the ground immediately behind to be self draining.

The wall was formed of composite panels of Larssen No. 4 Section box piles and No. 5 Section sheet piles, the box piles also acting as columns to support the deck slab. This was tied back by means of 2¾-in. diameter mild steel tie rods to mass concrete anchor blocks placed 95-ft. behind the coping.

Two rows of 14-in. x 14-in. reinforced concrete piles 56-ft. long support the middle and back of the deck slab, the piles being spaced at approximately 7-ft. centres longitudinally and 10-ft. across the wharf. Each pile had two blisters cast integrally with the pile at a distance of about 12-ft. from the toe, the cross section at this point being doubled. In most cases the blisters entered but did not pass through a fairly shallow layer of red sand.

14-in. x 14-in. reinforced concrete raker piles were also driven at about 14-ft. centres, their chief function being to take the loads from the coping mooring bollards.

The deck slab, 28-ft. wide, is a reinforced concrete flat slab, 2-ft. deep, on top of which is a wearing course of average depth of 7-in. which houses the crane and tram rails. The weight of reinforcement in the slab and wearing course is 16½ lbs/sq. ft. The wharf is equipped with two lines of sidings and 16-ft. gauge crane rails and is capable of carrying 15-ton travelling and 6-ton mobile cranes.

Crane rails are formed from two 85 lb/yd. bull head rails separated by cast iron spacer blocks and the siding rails are standard 126 lb/yd. dock rails. The latter are connected to the national system.

The deck slab is cantilevered 5-ft. 9-in. from the supporting box piles to form the coping. This is recessed at intervals of about 14-ft. to house the heads of the fender piles. These are Larssen No. 3 box piles 55-ft. long, on to which 12-in. x 6-in. elm rubbing strips are bolted.

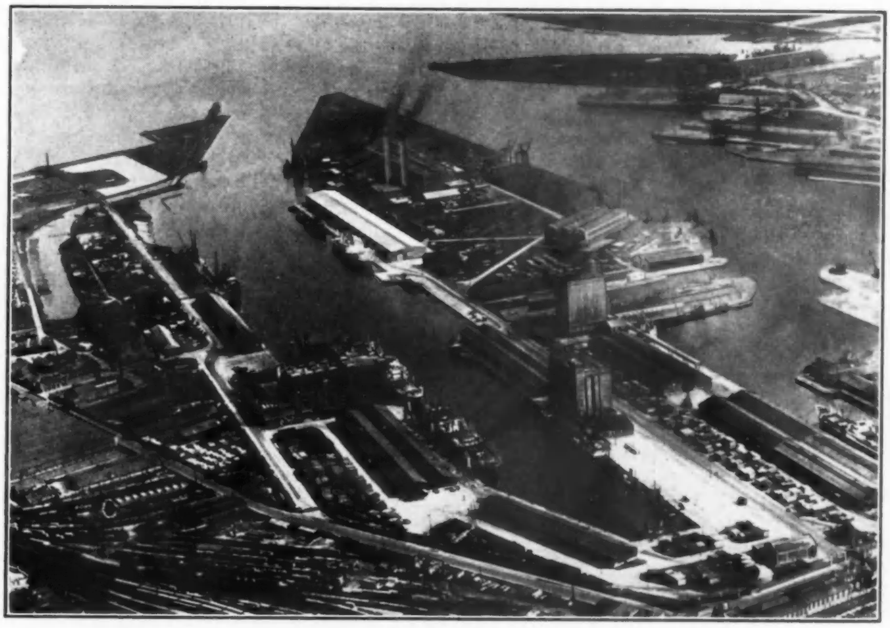
At the South end of the wharf a connection has been made to the existing wharf at Pollock Basin by means of a knuckle of similar construction. This gives the necessary access for the vehicular ship to shore connection in the adjacent berth.

About 270,000 cub. yards of material has been dredged from the front of the wharf and approaches, the material being used in the Commissioners' Co. Down land reclamation scheme.

Sinclair Wharf Shed

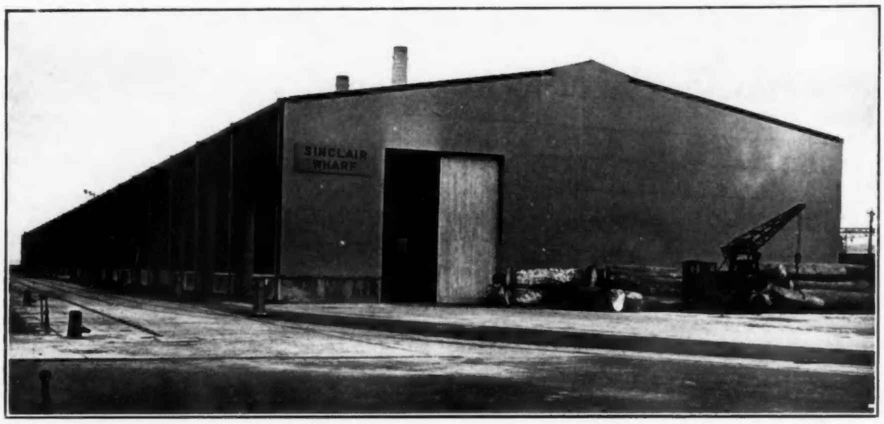
The accommodation is provided with a transit shed of structural steel 1,100-ft. long with a clear span of 120-ft. The shed stanchions consist of a 15-in. x 5-in. x 42 lb/ft. R.S.J. and two channels 9-in. x 3-in. x 17.46 lb/ft. riveted to the flanges. The stanchions, which are spaced at 20-ft. centres, are supported by two prestressed concrete piles 12-in. x 12-in. each 40-ft. long under each stanchion. The maximum load on any one pile due to loading from the shed is about 14 tons. This load will be increased to about 22 tons when a mobile crane travelling with full load passes over a gate race beam.

In the original design the stanchions supported a standard Pratt truss, but under certain conditions of loading it was found that reversal of stress occurred in the members on account of the light weight of the roof cladding. The truss was modified by reducing the lengths of the members as



The Dock system showing the new Sinclair Wharf and transit shed.

The Port of Belfast—continued



The new Sinclair Wharf and transit shed.

much as possible. The total weight of steelwork is about 584 tons.

The height of the shed is 36-ft. high at eaves level and 47-ft. high at ridge level. The clearance between the bottom boom of the truss and floor level is 29-ft. 9-in., enabling mobile cranes to operate in any position at maximum load.

The roof is clad with aluminium "Rigidal" Industrial Trough 6T sheeting 18 gauge at a slope of 10°. A concrete dado wall 5-ft. high is constructed at all fixed blinds and the sheeting used above is "Galbestos" corrugated protected metal 22 gauge.

The standard shed doorways are 19-ft. 3-in. wide by 20-ft. high. In addition one door in five is 28-ft. high to allow the easy working of mobile cranes. The doors are of timber construction, framed with Honduras long leaf pine and sheeted with spruce. The stiles of all the doors are laminated as they would be less liable to twist and would be of a better quality timber than would be possible to obtain in a large scantling. To ensure durability over a long period of time and because of the exposed site, a resorcinal gap filling glue was specified for laminating the stiles.

On the wharf side doors and fixed blinds alternate, and on the road side the doors are at 60-ft. centres.

Patent glazing with a 15° pitch at the apex of the roof covers about 15 per cent. of the roof area and is continuous for the length of the shed. The shed is lit by fluorescent lighting. The floor of the shed is of reinforced concrete 8-in. thick laid on consolidated hardcore not less than 12-in. thick.

Stormont Wharf

This wharf is situated on the West Twin, on the West side of the Victoria Channel. It is being provided chiefly to handle heavy electrical equipment to be shipped through the port by the British Thomson-Houston Co. from their new factory at Larne, Co. Antrim.

The wharf is 650-ft. long, the 200-ton crane being centrally sited. A berth 750-ft. long with 30-ft. at Ordinary Low Water will be dredged and provision is being made in the construction for the berth to be deepened to give 35-ft. at Ordinary Low Water. A transit shed is also being provided.

The ground conditions are similar to that at the Sinclair Wharf.

Foundation for Crane (See Fig. 2)

The crane foundation consists of 84 box piles Larssen No. 3 Section in lengths up to 82-ft., surmounted by a reinforced concrete cap 12-ft. deep. The whole is surrounded by a cofferdam, the space under the cap, which was largely below the water line, being filled with "Colcrete." Part of the mass of "Colcrete" is supported independently of the cap by means of twelve 12-in. square timber piles 35-ft. long.

The cofferdam was formed of Larssen No.

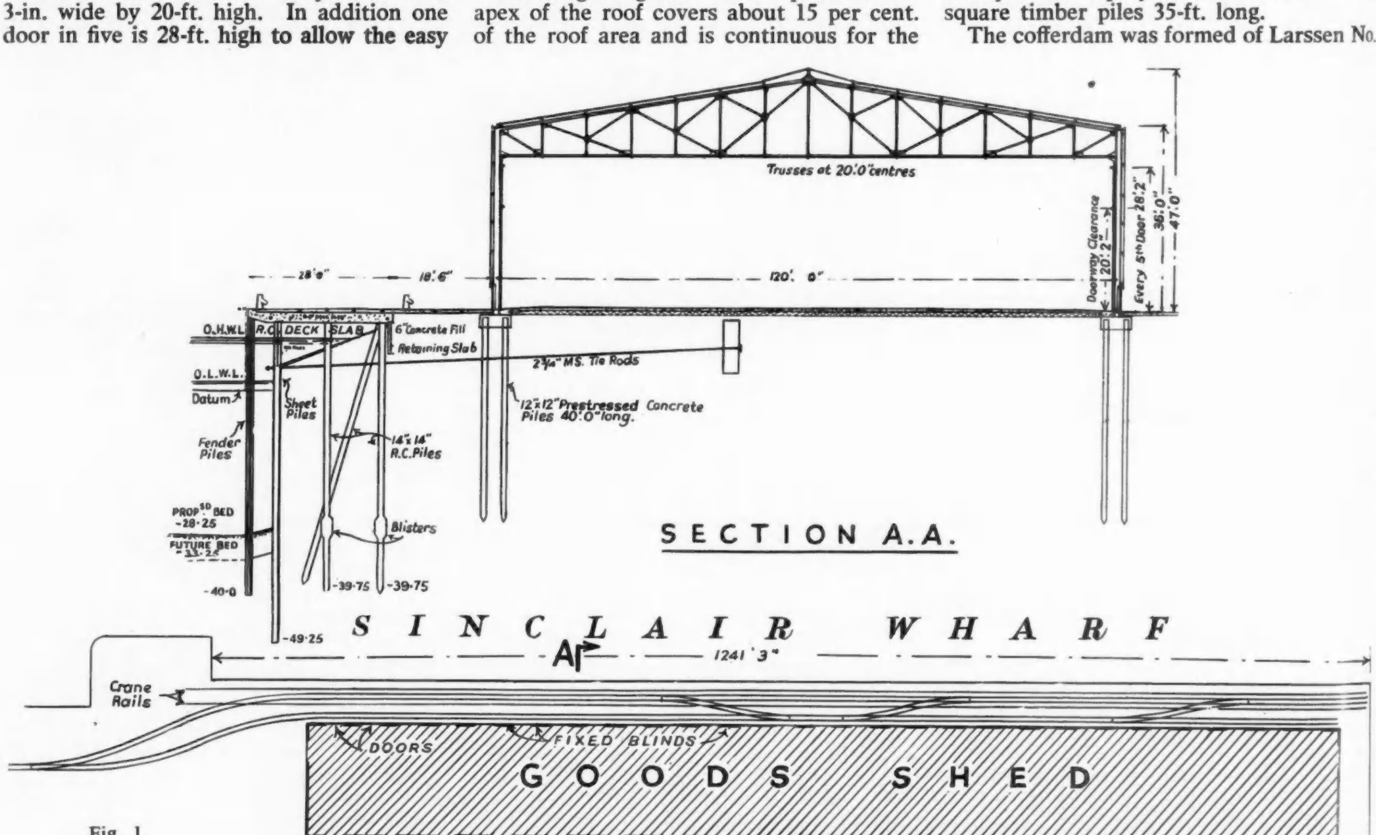


Fig. 1.

The Port of Belfast—continued

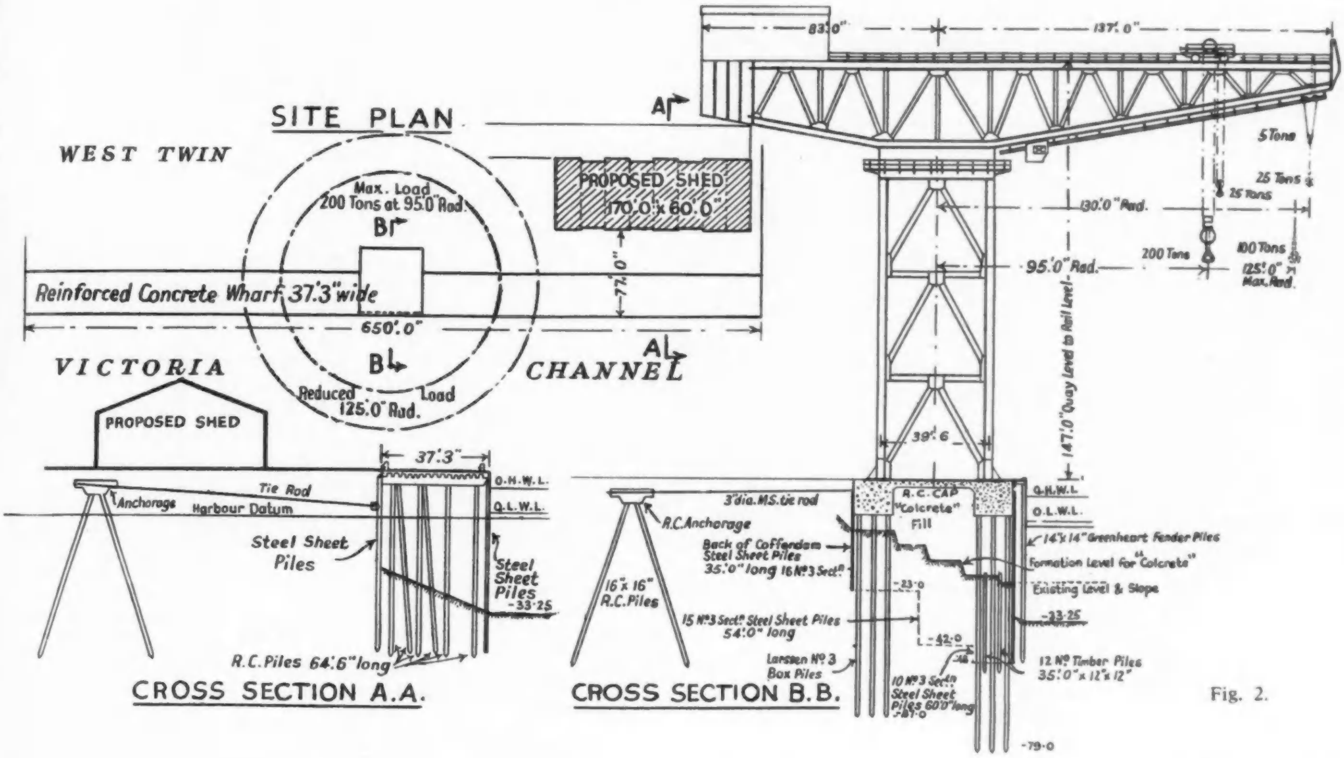


Fig. 2.

3 Section steel sheet piles in lengths up to 60-ft.

This structure forms a composite block some 56-ft. square with a depth varying from 18-ft. to 35-ft. Under the worst conditions of dead, live and wind loads, there is no uplift on the piles.

Provision is made to resist the crane wind loads by means of six mild steel rods 3-in. diameter concreted to a reinforced concrete piled anchorage some 143-ft. behind the coping line. This is a continuation of the wharf anchorage described below.

The crane tower is secured to the foundation by sixteen 3-in. diameter holding down bolts, 11-ft. long, embedded in the concrete.

The following are particulars of crane at present being erected:

The crane is a monotower cantilever crane designed to lift 200 tons at 95-ft. radius. The structure is riveted except for the four corner columns of the tower, which are of welded steel plates, box section, thus providing a clearer surface for painting.

The cantilever arms are of unequal length, the longer arm is 140-ft. and the shorter arm 83-ft., measured from the centre of rotation, to the extreme ends, and the overall height of the crane is about 166-ft. The unladen weight is about 1,250 tons.

A travelling trolley is mounted on the top of the long arm to transport the loads on the main hoist and the short arm is counterweighted with ballast blocks and the hoisting machinery, placed at the extreme end for the purpose of stability.

Four lines of rails, provided on the top of the longer cantilever arm to carry the main trolley, are 147-ft. above the quay level. The weight of the superstructure and the load is supported by two segmental girders, which carry the total weight to a live ring of rollers 40-ft. mean diameter. This in turn is centred with a robust construction of pin, sleeve and connecting castings to transmit the transverse forces from the jib through suitable pivot girders to the tower structure.

On the underside of the longer cantilever arm, at one side, a special track is fitted to carry a travelling trolley or whip hoist for dealing with loads up to 5 tons at high speed.

The crane is capable of hoisting, racking and slewing through 360°, in either direction. The three independent hoisting hooks operate at the radii shown below and each can be raised to 125-ft. above and 35-ft. below quay level.

Main Hoist—200 tons at 95-ft. radius; 100 tons at 125-ft. radius.

Auxiliary Hoist—25 tons at 130-ft. radius.

Whip Hoist—5 tons at 130-ft. radius.

The crane is electrically operated with current at 400 volts, 3 phase, 50 cycles. Telephones are installed to permit conversation between the cranedriver's cabin, machinery house and ground level. The crane is fitted with aircraft obstruction lights.

The crane will be tested by a 25 per cent. overload.

The remainder of the wharf, which extends for 300-ft. on both sides of the crane foundation, is 37-ft. 3-in. wide. It is of piled construction and can carry a 10-ton travelling crane and 7½-ton mobile cranes. Ten reinforced concrete piles, plumb and raker and varying in size from 15-in. to 16½-in. square, are driven to form bents at 14-ft. 6-in. centres and are connected by an in situ concrete "I" beam 3-ft. 11-in. wide and 4-ft. deep.

Precast secondary deck beams of T shape are laid on the bents. These beams have projecting reinforcement which is concreted in situ to make them fully continuous. In addition three similar but larger beams are placed under each crane rail together with a coping beam. The last is recessed to receive the fender piles and their housing. The heaviest individual unit is about 2¾ tons.

The deck and crane beams are screeded with a 6-in. deep wearing course of concrete. The weight of reinforcement in the deck and wearing course is about 25 lbs/sq. ft.

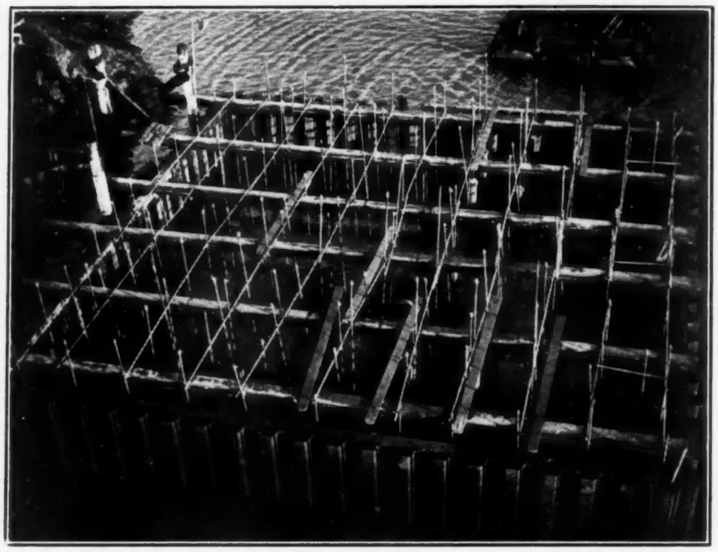
The greater part of the site is submerged and the ground level behind the wharf will be made up with filled material. This will be retained by a steel sheet piled wall placed at the back of the wharf. The wall is formed of Frodingham No. 5 Section steel sheet piling 61-ft. long and connected to an anchorage by 2¾-in. diameter mild steel tie rods placed at 8-ft. 4½-in. centres.

The anchorage is a continuous reinforced concrete beam, 15-ft. wide, secured to 16½-in. square reinforced concrete piles 65-ft. long, raked at 3½ to 1. The piles are spaced at 8-ft. 4½-in. centres on the compression side and at twice this distance on the tension side.

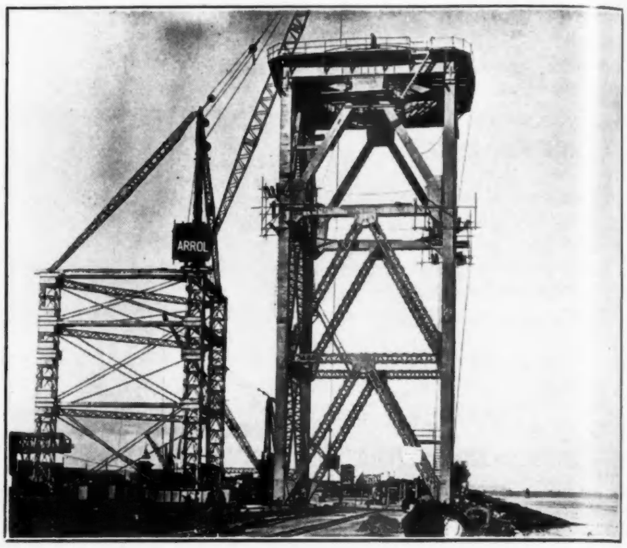
Stormont Wharf Shed

The shed will be 170-ft. long by 60-ft. wide and is of portal frame construction.

The Port of Belfast—continued



Cofferdam of foundation of 200-ton cantilever crane at Stormont Wharf.



200-ton cantilever crane in course of erection.

As the subsoil is poor, two prestressed con- concrete piles 12-in. x 12-in. each 40-ft. long will be placed under each stanchion arranged in the direction of the span of the frame, except where the stanchions can be carried by the anchorage block of the wharf. 15-in. x 6-in. x 45 lb/ft. R.S. Joists will be used for the portal frames which will be at 21-ft. 3-in. centres. The height of the shed will be 34-ft. 6-in. at ridge level and 21-ft. 9-in. at eaves level. Mobile cranes will be able to operate at maximum load at any position within a track 16-ft. 9-in. wide in the centre of the shed for its entire length.

The roof of the shed will be clad with aluminium "Rigidal" Industrial Trough 6T sheeting 18 gauge at a pitch of about 21°. A concrete dado wall 5-ft. high will be constructed at all fixed blinds and the sheeting above will be 24 gauge box rib "Galbestos." Patent glazing will cover about 21 per cent. of the roof area and will be continuous for the length of the shed. The shed will be lit by fluorescent lighting.

In the sides of the shed the doorways will be 20-ft. 9-in. wide by 17-ft. 9-in. high, and in the South gable the doorway will be 19-ft. 7-in. wide by 20-ft. high. The doors will be of timber construction, framed with New Orleans pitch pine and sheeted with spruce.

The floor of the shed will be of tarmac-adam laid on consolidated hardcore not less than 12-in. thick. At a later date the tar-macadam will be replaced by reinforced concrete after settlement has taken place.

Herdman Channel Wharf Extension

This wharf, which is at present under construction, is a continuation of the existing wharf on the West side of Herdman Channel. It will be about 1,212-ft. long overall, giving a length of berth of 1,083-ft. with a depth of 23-ft. at Ordinary Low Water. The Southern section, about 767-ft. long, is designed to allow for eventual deepening to 30-ft. below Ordinary Low Water. (See Fig. 3).

Southern Section

This will carry two lines of sidings together with crane rails for portal cranes, which will be of 7½ and 12-ton capacities. The rail details are similar to Sinclair Wharf. Mobile cranes up to 7½-ton capacity will also use the wharf. This section is being provided principally for the handling of container traffic.

The wharf is of reinforced concrete piled construction, consisting of four rows of 15-in. square vertical piles and two rows of 16½-in. square raker piles. The former support the deck slab and the latter's function is to resist the earth pressure behind the wharf, the filling being held in place by No. 5 Section Appleby Frodingham steel sheet piling.

The vertical pile centres are 6-ft. 3-in. longitudinally and 11-ft. 9-in. laterally, the close spacing being necessary owing to the heavy crane loading. The maximum length of the concrete piles is expected to be about 86-ft.

The reinforced concrete deck slab, 43-ft. 9-in. wide, is 1-ft. 10-in. thick, on top of which is a wearing course of 6-in.—9-in. thickness. The crane rails are 23-ft. 6-in. gauge for the cranes.

The width of the deck allowed the use of enough raker piles to obviate the need for an anchorage as in the Northern section. Thus the ground behind the wharf will be free from obstructions, an advantage in case of any future building work.

Northern Section

This will also be built on reinforced concrete piles, the size varying between 14-in. and 16-in. square and of lengths varying between 55-ft. and 63-ft. The wharf incorporates the foundations for the front of the transit shed and in addition it is designed to carry two 15-ton transporters, mounted on semi-portals. The rails for these are 112 lb/yd. bridge rail at 18-ft. gauge, the elevated rail being above the shed roof.

The deck slab is 1-ft. 10½-in. thick, with a wearing course 4-in.—10-in. in thickness. Owing to the narrower width, 27-ft. 7½-in., there will be space for only a limited number of raking piles and the thrust from the sheet piled retaining wall supporting the filling will be taken by a continuous sheet piled anchorage connected by 2¾-in. diameter mild steel tie rods in pairs at 15-ft. centres.

This anchorage will be formed from No. 2 Section steel sheet piles 14-ft. 6-in. long, their toes being about 17-ft. below ground level.

The foundations for the front of the shed and rear transporter rail are incorporated in the wharf and consist of groups of four 16-in. piles at 30-ft. centres. The loads will be transmitted by means of pile caps approximately 4-ft. 6-in. square and 2-ft. deep, these being the only projections below the otherwise flat soffits of the deck slab throughout the wharf.

Both sections will be provided with fenders spaced at 12-ft. 6-in. centres and recessed into the deck slab. The standard fenders, which are brought up to cope level, will be formed from 12-in. square greenheart piles and faced with a 12-in. x 6-in. elm rubbing strip.

As the class of ship using the wharf has a projecting belting which may on occasions ride above the deck, a number of fenders will project 9-ft. above cope level. These will be formed of 16-in. x 12-in. greenheart piles faced with a 12-in. steel plate 1-in. thick.

Transit Shed

The shed will be 690-ft. long and will vary in width from 62-ft. 8-in. to 128-ft. 7-in. and will cover an area of about 63,274 sq ft.

The Southern portion of the shed is of portal frame construction for a length of 330-ft. and width 62-ft. 8-in. with 15-in. x 5-in. x 42 lb/ft. R.S. Joist frames at 15-ft.

The Port of Belfast—continued

centres. The height of the shed at ridge level is 35-ft. 6-in. and 24-ft. at eaves level. Patent glazing will cover about 20 per cent. of the roof area and will be continuous for the length of the shed.

The Northern portion of the shed will be 360-ft. long and will have a general width of 108-ft. 7-in. On the wharf side two bays into the shed each 60-ft. long by 11-ft. 7-in. deep will be provided for the loading and discharge of vessels by transporter cranes. The structure of each crane will be supported by a rail at wharf level and by a rail at roof level. A plate girder beam 7-ft. deep in the roof space of the shed will support the back transporter rail and also the trusses of the shed. The foundations for the shed will be piled where they are not supported by the wharf structure.

The main stanchions support Pratt roof trusses which will have a slope of 11°. Patent glazing at the apex of the roof at a slope of 15° will cover 15 per cent. of the roof area.

The height of the Northern portion of the shed at eaves level varies because of the irregular outline of the shed, the height at ridge cap level will be 38-ft. The clearance between the bottom chord of the roof truss and floor level will be 20-ft. 3-in.

The roof of the entire shed will be clad with aluminium. A dado wall 5-ft. high will be constructed at all fixed blinds and the sheeting above will be of protected metal. All the doors will be of timber construction.

About 100,000 cub. yards of spoil will be removed from the front of the wharf.

The wharf and shed are due to be completed in 1960. Together with the existing Herdman Channel Wharf, they will provide a continuous straight berth over ½ mile in length.

Victoria Channel (See Fig. 4)

In addition to the new accommodation the channel leading into the Port, Victoria Channel, is being widened and deepened from the Twin Islands to seaward and a larger turning basin provided.

The existing channel, 300-ft. wide, gives 23-ft. depth at Ordinary Low Water. The new width will be 400-ft. and the depth 28-ft. at Ordinary Low Water. The turning basin, which will be 1,400-ft. in diameter with the same depth as the channel, will be dredged at the junction of the Victoria, Musgrave and Herdman Channels.

The work is also being extended southwards to Stormont Wharf but owing to the presence of submarine power cables the depth at Ordinary Low Water will be 26-ft. in this section.

The work will enable ships up to a gross tonnage of 46,000 and 33-ft. draft to use the port and, in adidtion, tankers up to 65,000/85,000 tons can be catered for in the shipbuilding yards in Belfast.

The dredged materials will be pumped ashore, partly in the reclamation area at Garmoyle, Co. Down, and partly in a new area on the Co. Antrim side of the harbour which will be reclaimed.

In all nearly 3,000,000 cub. yards of material will be removed.

Conclusion

The principal contractors for the works are given below.

Sinclair and Stormont Wharves and 200-ton Crane Foundation — Messrs. Charles Brand and Son, Ltd., London.

200-ton Crane—Sir William Arrol and Co., Ltd., Glasgow.

Sinclair Transit Shed—Messrs. Harland and Wolff, Ltd., Belfast.

Herdman Channel Wharf Extension—Concrete Piling, Ltd., Belfast.

Dredging, Victoria Channel—Westminster Dredging Co., Ltd., Bromborough.

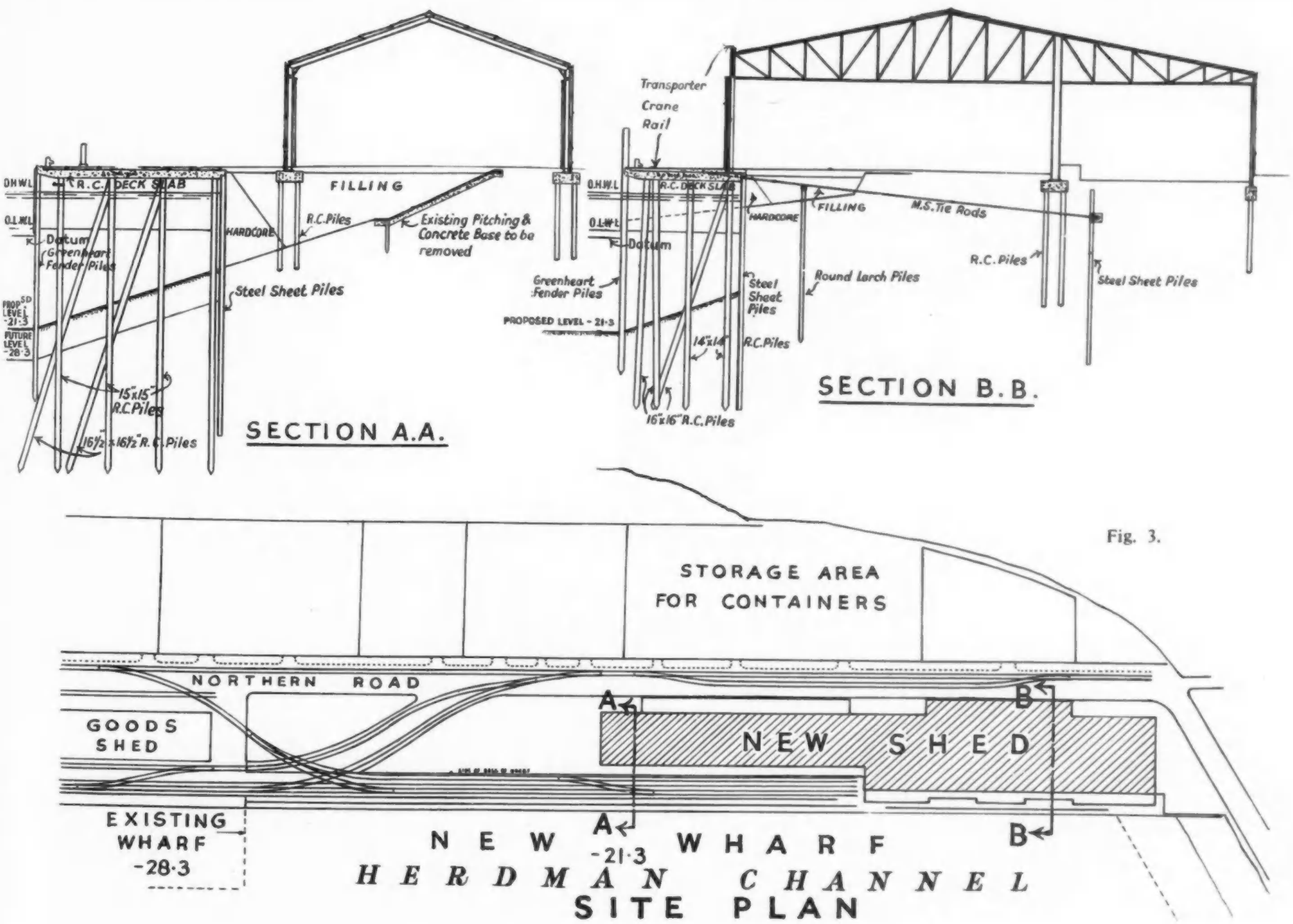


Fig. 3.

The Port of Belfast—continued

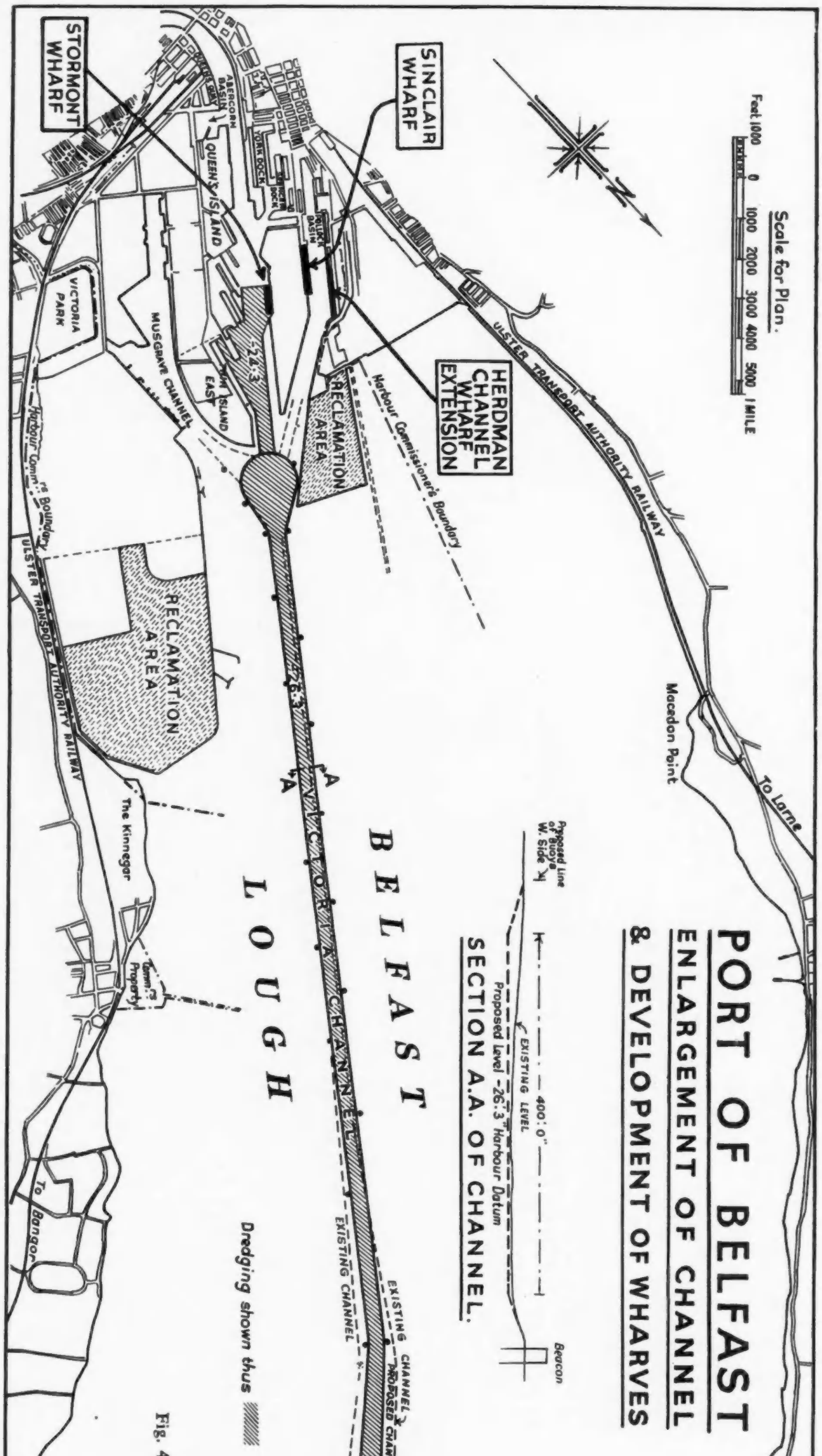


Fig. 4

The contracts for the remaining transit sheds have not yet been placed. The numerous ancillary works such as roads, sidings, services, dredging of berths, etc., are being carried out by the Commissioner's staff and with their own equipment.

The works have been designed under the direction of the Harbour Engineer, Major John H. A. Patton, M.B.E., M.C., T.D., M.A., M.A.I., M.I.C.E., who, on his retirement at the end of 1956, was succeeded by Mr. J. F. McNeill, M.Sc., M.I.C.E., Messrs. Harland and Wolff, Ltd., collaborated in the design of the transit shed at Sinclair Wharf.

Acknowledgment is made to Messrs. Charles Brand and Son, Ltd., for permission to reproduce some of the photographs.

Port of Pasajes Development

Berth Extension and Dry Dock

It has recently been announced that the Port of Pasajes in North Spain is to be provided with new berths totalling some 3,600-ft. in length. Upon completion of the work, it is estimated that this port which last year handled a total of 1,541,000 tons of imports and exports will have an annual capacity of 3,000,000 tons. The berths will be constructed of reinforced concrete caissons, 30-ft. sq. and 45-ft. in height. The shore side cells of each caisson will be filled with sand and the remaining cells with water, and the caissons will be sunk on specially prepared bases of rubble and sand. The space between the caissons and the shore will be filled in, and the scheme also comprises the construction of sheds, rail and road facilities and the installation of 21 gantry cranes.

Pasajes is situated in a large natural basin and connected with the sea by a channel some 4,000-ft. in length, 320-ft. in width at its narrowest point, and with a minimum depth of 36-ft. The depth of water alongside the new quays is 32-ft. at low water spring tides.

The increasing traffic using the port has stretched the existing berthing facilities to the maximum and tankers are already using the length of new quay which has so far been completed, although much of the handling equipment has not yet been installed.

At the present time, there is about 3,500-ft. of berthing accommodation, with water depths alongside ranging from between 15 and 24-ft. The rate of working of the quay gantry cranes has averaged 8.8 hours per working day.

A further scheme has been drawn up and awaits Government sanction for the construction of a dry dock to accommodate ships of up to 465-ft. in length. It is estimated that this dry dock could handle an average of 40 tankers per annum. The existing floating dock accommodates ships of up to 250-ft. in length and, together with two slipways, serves not only the commercial shipping, but also the 280 fishing vessels based at Pasajes.

New Commercial Dry Dock at Karachi

Novel and Economic Design

(Specially Contributed)

FOLLOWING the establishment of Pakistan as an independent state in 1947, the country suffered from the lack of dry dock facilities, and it was therefore necessary to initiate schemes to provide such accommodation for both the country's naval and merchant fleets. In 1954 a dry dock was completed within the Naval Dockyard at West Wharf in Karachi; this is a gravity type dock with a floating gate. Before its construction, the only dry dock existing in Karachi was a small one of some 240-ft. in length, 45-ft. in width and a depth over the sill at H.W.N.T. of 11-ft. 6-in. This dock, which is operated by the Karachi Port Trust, was completed in about 1860, has step altars and a swing type gate.

In 1953 the Pakistan Industrial Development Corporation commenced construction work on a site at West Wharf for the establishment of a shipbuilding yard incorporating a dry dock, capable of handling oil tankers up to 22,000 tons deadweight, passenger ships of up to 20,000 tons displacement and cargo vessels of up to 18,000 tons deadweight. Competitive tenders including design were invited from contractors of international repute in 1954, and the successful tenderers were Messrs. Gammon Pakistan Ltd., who are a member of the Gammon Group and whose sister company, Messrs. Gammon (Malaya) Ltd., recently completed a dry dock of similar proportions at Singapore. Messrs. Gammon submitted a novel design resulting in an economic price, which was accepted by the owners after approval by their Consultants, Messrs. Stulcken Sohn of West Germany, whose specialist consultant was Dr. Erich Lackner.

Soil Investigations

Soil conditions on the site were extremely difficult and the natural water table existed approximately 3-ft. below ground level. Much of the ground at the seaward end was newly reclaimed and it was obvious from the outset that the problem of dewatering would present considerable difficulty. The sub-contract for the de-watering operations was let to Swissboring Overseas Corporation Ltd. of Karachi. This Company submitted a detailed report of their findings after carrying out explorations on site and experiments in laboratories in Europe. Over 40 exploratory percussion borings with an average spacing of 50—60-ft. and also some pumping tests were made to determine the permeability of the soil. These latter were particularly useful for the information gained in connection with dewatering of the soil for the dock excavation.

It was generally found that the sub-soil formation was not uniform and consisted for the most part of sand layers with intermixture of clay particles. In places shell and fine gravel were also discernible. In some of the bore holes, highly compact clay layers of varying depths were encountered, but after plotting the geological sections, these were shown to exist only in the form of lenses and not as any uniform strata. The results of the tests proved an ultimate bearing capacity of nearly 5 tons/sq. ft. (allowable 2.5 tons) at the foundation level, but since the whole structure of the dock would be subject to uplift, the ground pressure would not be so high and therefore there would be no settlement.

General view of dock under construction.

Construction of the Dock

The dock is 626-ft. 2-in. in length with a width of 90-ft. between the cope cantilevers and provides a depth of water of 38-ft. over the sill at H.W.N.T.

In order to achieve an economic design, the Contractors avoided a gravity dock scheme and put forward a design utilising a comparatively thin reinforced concrete floor slab, 6-ft. thick, which was anchored against hydrostatic uplift (Fig. 1).

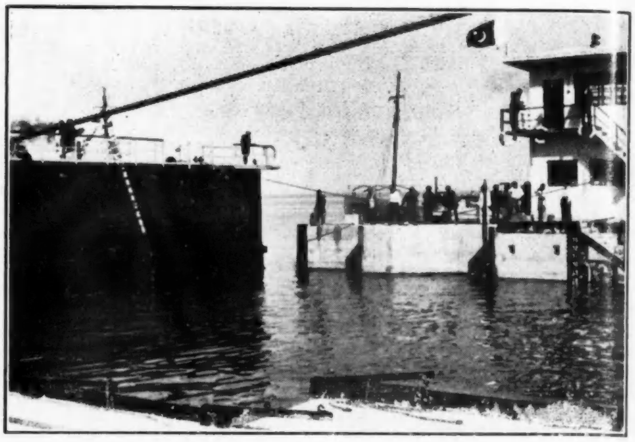
The dock floor is 22-ft. below mean sea level with top of walls at 16-ft. above. To avoid considerable dredging of the channel and to give a better approach to the entrance of the dock, the axis of the dock was angled seaward and is inclined at an angle of 56° 49′ to the new shore line.

The whole dock is divided into six sections by five expansion joints. The four intermediate sections, A.2, B.1, B.2 and C.1 are each 100-ft. in length. C.2, which is nearest the entrance, is 137-ft. 10-in., and A.1 at the head of the dock is of trapezoidal shape. There is a slight variation in the system of loading from section to section, but the overall design principles remain the same. The whole construction is in reinforced concrete cast in situ.

The walls were designed as cantilever retaining walls to resist the following forces: (a) earth pressure, (b) hydrostatic pressure, (c) pull on the bollards, capstans, fairleads, etc., (d) surcharge load on backfilling, (e) side thrust of the crane wheels, (f) impact of ships. The walls carry a service gallery, located at a level of 9-ft. below cope level of the dock. All the required services are sited on this gallery, including fresh water, A.C. and D.C. electrical power, compressed air, oxygen and acetylene and telephones. Sufficient lighting is provided for night work to be carried out under safe conditions.

Construction of the walls was so planned that each wall together with its 36-ft. wide base was completed to full height leaving a 7-ft. wide construction joint between the central 44-ft. wide dock floor slab and the wall base. The structural significance of

New Commercial Dry Dock at Karachi—*continued*



(Above) Completed dock looking towards the headwall.

(Top right) Closing of gate during the Opening Ceremony. Pump house on right.

(Bottom right) The first vessel entering the new dock.

the joint is fully explained in the design of the floor slab and was kept at 7-ft. to allow for complete overlapping of reinforcement, from either side and to give sufficient working space.

The Blocking Pad

Since this construction joint, or the seal between the floor slab and the footing had to be concreted once a hydrostatic pressure equivalent to 18-ft. head of water existed below the floor slab, a reinforced concrete slab 13-in. thick had to be provided below the joint spanning between the floor and footing edges. This blocking pad was needed to keep the joint and dock floor as dry as possible until the concreting had taken place.

Before filling in the joint three stages required to be completed: (i) Backfilling behind the walls to a level of 0.00, (ii) the dewatering to be withdrawn to allow the ground water level to rise to −10.00, (iii) the floor anchorages to be fully stressed. However, the section of the wall and footing was designed to resist the earth pressure due to the complete backfilling and water level standing highest at +11.00. (The lowest water level being −15.00 for design purposes). Nevertheless, later, it was decided to provide the structural connection between the floor slab and wall before the whole backfilling was done and dewatering completely withdrawn, for the following reasons:—

1. To decrease the ground pressure at the toe of the wall footing, thus transferring the various pressures on the wall to the floor slab through fixed end moments and distributing them along the whole length of the slab between the two walls. This also relieved the pull on the external row of floor anchors.

2. If concreting had waited on the completion of the backfilling, the completion of the floor slab would have been delayed, as the backfilling could only be finished after the craneways on either side and the ancillary buildings were constructed over the backfilling at 0.00 level. There were other practical difficulties apart from this.

The profile of the wall section was so determined that at any horizontal section of the wall, the tension of the concrete would be within safe limits. From this consideration, the stress in steel was kept at 18,000 lbs./sq. in. The cantilever of the footing embedded in earth causes a statical moment due to the filling on top which counteracts the fixed end moment of the dock walls and thereby reduces edge moments in the dock floor, and hence relieves overstressing of end anchors of the floor slab which otherwise would have had to be increased in number. For calculation of the forces due to the pressure of the well-compacted cohesionless soil backfilling, Rankine's theory of earth pressure was employed.

On all faces exposed to water, the concrete cover to reinforcement was 3-in.

The Floor Slab

In formulating the design of the floor slab the theory of a beam on elastic foundations was utilised*. It has a thickness of only 6-ft. as against 20-ft. thickness of a gravity dock design, and is anchored against hydrostatic uplift by means of 242 No. high tensile wire cables to a clay stratum which underlies the dock site at a depth of about 50-ft. below the top surface of the dock floor. The shear strength of the clay was found to be more than 2 tons per sq. ft. with very good bearing qualities. The slab was designed to sustain point loadings from the anchorages as well as superimposed loads from a docked vessel; it was also designed to resist loads from hydrostatic pressure on the side walls and also loads and impact forces imparted to the walls by the shipyard cranes, bollards, capstans, etc. (See Figs. 2a and 2b.)

* "Beams on Elastic Foundations" by M. Heteni, Oxford University Press.

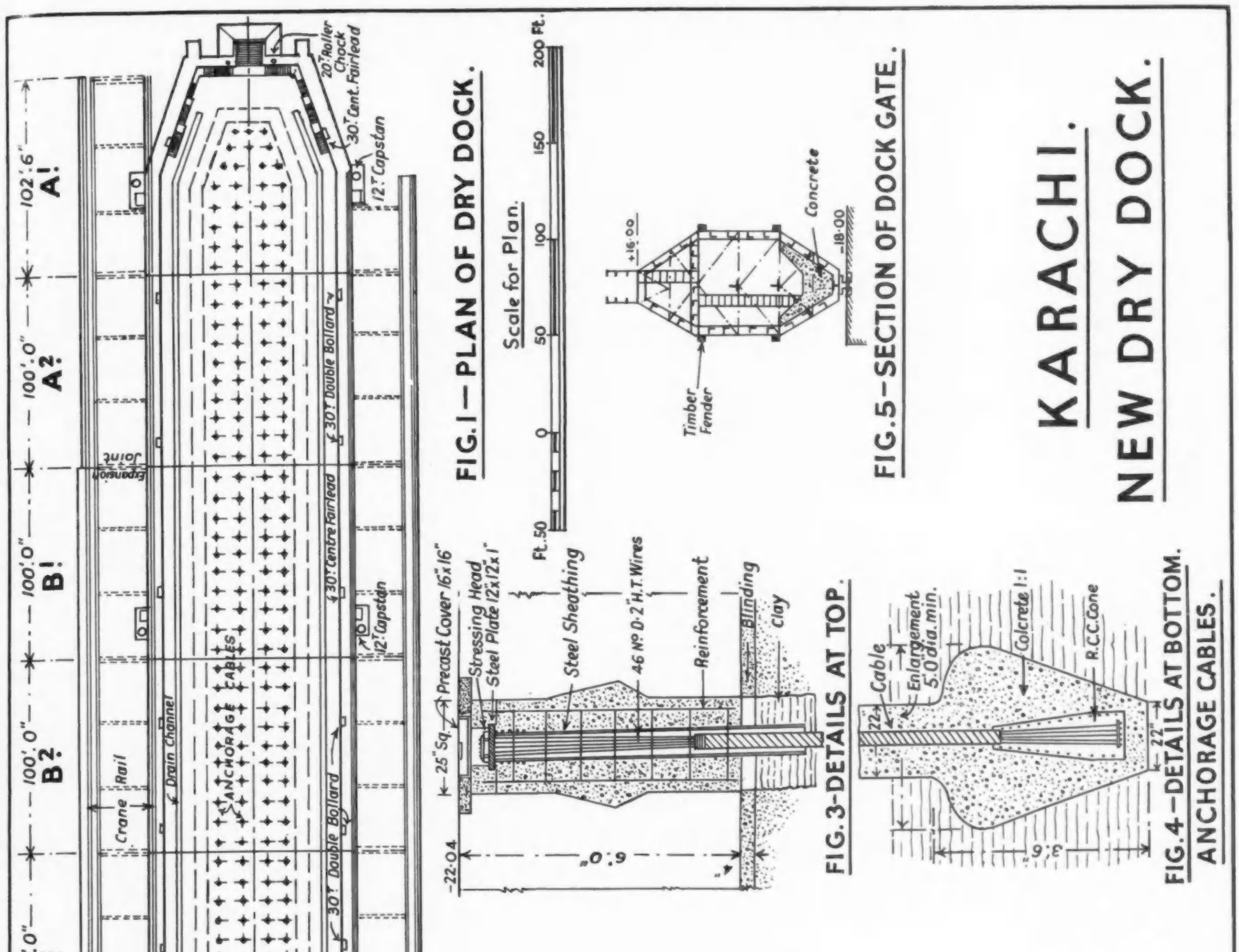


FIG. 1—PLAN OF DRY DOCK.

FIG. 2A—TYPICAL CROSS SECTION.

FIG. 2B—TYPICAL SECTION THROUGH A DRY DOCK OF SAME SIZE & OF ORTHODOX DESIGN WITH ALTARS FOR SHORING INSTEAD OF ADJUSTABLE BILGE BLOCKS.

FIG. 3—DETAILS AT TOP.

FIG. 4—DETAILS AT BOTTOM. ANCHORAGE CABLES.

FIG. 5—SECTION OF DOCK GATE.

New Commercial Dry Dock at Karachi—*continued*

The anchorage cables, each consisting of 46 No. 0.2-in. diameter high tensile wires, were each stressed to 100 tons and the average loss of stress in them after six months when a check was carried out, did not exceed an average of 3%. Figs. 3 and 4 show details of the top and bottom ends of these anchorage cables. The foot comprises a bottom anchor plate of hard silicon steel 11-in. x 11-in. x 1-in. thick into which the high tensile wires are secured by a patent method. Around this anchor plate and the bottom 3-ft. of the cable was cast a reinforced concrete truncated cone. The stressing head consists of a 12-in. x 12-in. x 1-in. thick hard silicon steel plate through which the high tensile wires pass and are anchored into the main stressing head. The top part of the cable where it passes through the dock floor is sheathed with a steel casing, the remainder of the cable between the head and toe being protected against corrosion by means of five layers of bituminous cotton tape. Sparings of adequate size were left in the dock floor and through these a casing was sunk providing a 22-in. diameter bore down to the clay stratum referred to above.

After this casing had been sunk to the full depth, a man was lowered to the bottom where, by means of a small pneumatic clay spade, he was able to bell out the bore to provide a suitable anchorage bulb. Details are shown in Fig. 4. The prefabricated cable was then lowered into position and the truncated cone was held firmly by means of grouting the belled base with 1 : 1 Colcrete colloidal grout. After a suitable period the anchorages were stressed and, as completed, provided a minimum factor of safety of 1.5. Since the stability of the dock depends entirely on these anchorages, the supervision of this work at all stages was of the utmost importance and was carried out under subcontract by Messrs. Swissboring Overseas Corporation Ltd., who, as mentioned earlier, were also responsible for the subsoil investigations.

The Pump House

The pump house is incorporated within the main dock structure on the north side at the seaward end and is of monolithic construction. Water enters through an inlet channel which has a rectangular opening on the west wall of the house and is situated 13-ft. above the dredged level of −25.00. This inlet channel terminates at the filling culvert below the sill and this filling system is large enough to allow the dock to be filled within 30 to 45 minutes. An electrically operated sluice valve, which can also be operated by hand in an emergency, is fitted across the inlet channel inside a valve shaft.

The culvert has been so designed that when flooding the dock, the water will rise in the vertical direction through the rectangular openings along the top of its length. This ensures that the ship, while rising, is not disturbed by vortex currents of water. Investigations into the filling and emptying process were carried out in Germany on a model of this dock before the final design was formulated.

Three electrically driven pumps with anti-syphonic discharge were installed in the pump house. In the anti-syphonic system, the use of reflex valves and sluices is avoided. Air relief valves are provided at the top of the syphons to stop the water syphoning back into the dock and to prevent air locking. These valves are automatically operated by the force of discharging water and so are open when the pump is not working. Any two of the pumps are capable of emptying the dock in $2\frac{1}{2}$ hours. The water content of the dock when filled is 14 million gallons.

A collecting basin is provided in the dock floor near the pump house and is connected with the main sump immediately below the floor of the house. This basin is connected with the longitudinal open drain channels of the dock and filling culvert. Two smaller pumps are provided to pump out the remaining water. For fire extinguishing, there is a special pump which draws water direct from the sea. Access to the pump house is through adjacent storage rooms and there are openings in the roof above each pump for their removal or repair.

Drainage of Dock Floor

Two open channels 2-ft. wide run the length of the dock floor at a distance of 36-ft. on either side of the centre line—a position where very small bending movements occur. The floor is sloped to these channels which have precast R.C. concrete covers.

Service and Provisions

Craneways are provided along both sides of the dock designed to carry 30 ton shipyard luffing cranes with a wheel base of 32-ft. 10-in. Initially however, only one 10 ton capacity crane has been installed.

The craneway beams carrying the crane rail remote from the dock wall on both the north and south sides presented an interesting engineering problem. This was solved by provision of a reinforced concrete beam of constantly varying depth, which will form the side wall of the future slipway berth adjacent to the dock. This beam was designed on the theory of elastic foundations, taking into account the elastic deformation of the patent Colcrete piles on which it was founded. These piles were driven to a depth of approximately 40-ft. through newly filled ground to an adequate set. The Colcrete piles are a patent of the Contractors and, in addition to the 176 piles driven for these craneways, more than 3,000 similar piles were driven for the foundations of the main shipyard craneways, main shipbuilding hall and other ancillary buildings.

Storage Rooms

For storage of materials, two large store rooms have been provided, one each on the north and south sides of the dock.

The Switch House, a double storeyed structure, is located over the pump house and a large transformer sub-station is placed on the south west corner of the dock near the entrance. Electric cables, carried on brackets, run the length of the walls below the top wall cantilever and feed the electrically operated equipment, such as the pumps, valves, gates, lights, capstans, electric cranes, etc.

Capstans

The main dock capstans, of which there are three on each side of the dock of 8 and 12 tons capacity, are electrically driven and are controlled by means of foot operated switches. Normal fairleads, mooring rings, bollards, etc., are provided.

Adjustable Bilge Blocks

A novel feature of the dock is the provision, on either side of the orthodox keel blocks, of fourteen adjustable bilge blocks. These are to support the hull of a vessel near the turn of the bilges on either side and are adjusted by means of hand winches installed on the dock coping. These bilge blocks obviate the necessity of fixing shores and should result in considerable economies in time and labour costs.

Inside the dock cope, teak wood fenders to absorb impact have been provided. These are secured by angle iron and are also bolted to an edge plate.

Dock Gates

The floating dock gate is of welded steel construction and was fabricated in the Shipyard. It has a gangway on top, is symmetrical in section and is constructed so that either side can be made to abutt against the wall by turning the gate through 180° (Fig. 5). Provision has been made for a second gate to be installed at a later date.

The Warping-in Jetty

In addition to the dock proper, a warping-in jetty 118-ft. long has been provided as an extension to the dock wall on the south side. It is constructed of a double row of anchored steel sheet piles 60-ft. long, spaced 24-ft. 4-in. apart and filled with loose boulder filling. It will also serve the purpose of handling and parking the dock gate, and in view of its location will significantly reduce the time spent in moving the gate in and out of position.

Construction Details

Construction work on the site was commenced in July, 1955, and the project was completed, except for minor items by December, 1957. Excavation involved a total quantity of 200,000 cu. yds. of soil and was carried out by means of one $1\frac{1}{2}$ cu. yd. and one $\frac{3}{4}$ cu. yd. capacity dragline excavators working with 3 cu. yd. capacity dumpers. Much of the excavation from the early stages of the work at the head of the dock was used to reclaim land which was later used as a working area behind the temporary coffer dam, which was driven about 70-ft. seawards of the dock entrance using Frodingham No. 3 Steel Sheet piles in a single line.

(Continued at foot of following page)

United Kingdom Ports and Shift Working

Would Ship Turnround be Facilitated ?

(Specially Contributed)

The docks can be quiet places at night time. An occasional vessel at work, the noises of ships on the move between the entrance and their berths, the shunting of trucks in a distant marshalling yard, the clanking of a dredger working alongside a wharf or the measured tread of a patrolling policeman, these are the only signs that capital installations and expensive equipment are not lying entirely fallow. Quay cranes, in converging ranks on opposite sides of the dock, are still; their jibs, of the latest pattern that will plumb sheer across the largest cargo carrier, are lost in the darkness of the night sky. Watchmen emerge on deck as they hear on the gangway the footfall of a member of the crew returning to a ship where the hatches are covered and the winches are at rest.

With a few exceptions this is the general picture. As with any statement made on conditions in ports there are always exceptions. Garston and Middlesbrough do work on a two-shift basis and in South Wales ports there is a substantial measure of two-shift working with provision for an occasional third shift. Night shifts on a scale different from day conditions are worked on certain berths, both in Liverpool and Southampton.

New Dry Dock at Karachi

(Continued from foot of previous page)

The project required a total quantity of concrete of only 40,000 cu. yds. A batching plant, including electrically driven concrete mixers was established, together with cement silo, underground boot and air slides. Aggregates were fed into this plant by means of a small excavator with a grab. Concrete was handled into position by means of concrete buckets mounted on Deccaville tracks and also by means of two mobile electrically driven scotch derricks which commanded the whole of the working area. All concrete was vibrated when placed by means of pneumatic poker type vibrators.

Daily tests were made in the site laboratory on all the concrete poured and, with few exceptions, test results exceeded by a considerable margin the specified values. All formwork was of timber construction and was handled into position by means of the scotch derricks, which were also used for handling the reinforcing steel as required.

The design, supply and installation of the mechanical and electrical works was carried out under the supervision of Messrs. Stulcken Sohn.

The dredging work for the access channel to the Dock was carried out under a separate contract by the Overseas Dredging Co., Ltd.

At all other ports including London, Avonmouth, Hull, Manchester and Glasgow work is fundamentally on a single shift basis.

Both Mr. F. D. Arney, general manager of the Port of Bristol Authority and Mr. H. Leat, chairman of the Institute of Shipping and Forwarding Agents (1) have drawn industrialists' attention to the position. Both made a plea for a reasoned consideration of shift working to replace the present inertia that descends on many of the ports during the major part of each 24 hours. Both emphasised the waste of capital and labour that the present restricted working entailed. Neither has the position been improved by the trend, apparent in the last decade, against the working of the long hours of overtime, which found general acceptance until 1939.

Whilst hours of work in each port are governed by custom and usage, few shipowners until the Second World War met with objection from labour when it was necessary to work continuously, either on discharging or loading. "The winches won't stop" was the usual method of meeting an emergency caused by disaster, industrial troubles elsewhere, or even a mere accumulation of cargo. In such cases work went on continuously day and night. Men taken on at 8 a.m. worked—with breaks for meals—until 7 a.m. the following day. They were replaced by alternative labour who, in their turn, gave away to the original gangs, refreshed by 24 hours' rest. Some employers regarded these conditions as penal; those who regularly resorted to such methods found in them much to their financial advantage and but little administrative handicap. Today, all-night working is exceptional. When a decision, often taken locally, served to bulk three shifts into one, there was little need to discuss shift working in the abstract.

Implications of Proposed Changes

What is implied in the suggested change? Firstly, it is envisaged that there should be three consecutive working periods. Shift A from 6 a.m. until 2 p.m. Shift B from 2 p.m. until 10 p.m. and Shift C continuing for the eight hours until 6 a.m. the following morning. The "Methods of Improving Organisation of work and output in ports" (Inland Transport Committee of the International Labour Organisation, Hamburg 1957) quotes opinions from both Australia and India on suitable lines of approaching the problem. The former considers that "a greater labour force permitting the working of more twilight and midnight shifts would have assisted turnround" (2). The latter suggests that the working of two shifts should be made compulsory in the interests of ship turnround. The working of a third shift (and here there is understanding of the operating and maintenance problems that will later be discussed) should be subject to the consent of the port authority (3). It is visualised that normally, men should enjoy a rest period after each shift. However, they could and should be allowed to work two consecutive shifts on occasion. It is accepted that each shift is relatively short. Working of a third consecutive shift is to be prohibited—this in spite of the prevalence of 24 hour working only two decades ago. Overtime rates would be paid for work done beyond the first shift. By staggering meal times — assuming that gangs are sufficiently large, and that the job is suitable—it is thought that work could proceed uninterruptedly throughout the shift. Output would thereby exceed that produced by a system of continuous working that carried with it generous mealtimes. Staggering of mealtimes also embodies the principle that much dock work is too arduous for men to continue beyond three hours without refreshment. It is urged also that a good and sufficient service of hot meals must be readily available on the spot. Particularly should this apply to the night shift, a welcome advance on the pre-war concession to labour of half-an-hour's break during "the dead hours of the night." This was given so that "the men may be afforded an opportunity to consume such refreshment as they may have brought with them." The difficulty of organising hot meals could no doubt be overcome; there would need to be more training undertaken before alternative crane and winch drivers could be integrated into a system of staggered meal-breaks.

Labour Resources

It may well seem premature to settle the niceties of contiuous working and the provision of amenities to the men engaged, until it can be certain that there will be sufficient men available to be engaged. Once more the would-be reformer and the planner uninhibited by practical experience, founder on the hard facts of the shipping industry. Only too often has it been the experience of the practical dock operator to evolve a scheme for better gang working only to find that his plans have coincided with an unlooked for recession in trade. Hardly a year passes without a temporary slump in port work, sufficient to transfer a sizeable proportion of the register from the full piecework pay packet to the meagre "fall-back." Factories are often able to plan their shift work for weeks ahead. A few days fog is enough to wreck the best laid plans of port authorities and master stevedores.

What are the present labour resources and how do they measure up to the demands made by the single-shift working, that with a small overtime supplement, now largely composes the working day? On the register of transport workers maintained by the National Dock Labour Board are some 75,000 names. Included in these are the "C" men who, by reason of age and disability, have only a restricted usefulness. How can an industry plan ahead for shift working when the variation in both the

United Kingdom Ports and Shift Working—continued

main ports of London and Liverpool between the maximum and the minimum daily demand is as much as 7,000 men? (4).

The register is made up of ship, quay and warehouse men, excluding for the moment such specialists as tally clerks and lightermen. The register maintains a balance, based on experience, between the respective demands for these three types of labour. Whilst there is no hard and fast line separating the three main branches of transport work, the last named who are the specialists in commodity handling, are hardly available for ship work. Where the port specialises in overside discharge and loading (i.e. to and from barges), the proportion of ship men will be high and vice versa. Overside work is, by its nature, more "contained" than quay work. Neither quay gangs nor the dock shed have to be paid for when working overtime. B and C shifts would, therefore, tend to exploit overside conditions. The complement of ship men in a largely overside port such as London would have to be multiplied twice, or perhaps three times More quay men would also be needed. Specialists in warehousing would, from time to time, be called upon to work more than the day shift. During the timber season, for instance, deal porters would have to play a greater part in releasing craft and clearing quays.

Specialised Training

To increase the register sufficiently to cope with shift demands in a time of full employment, could be done only in competition with industries offering conditions more attractive than those in the ports. Given the requisite labour the Board would have to inaugurate an intensive system of training for stevedores and dockers, for transport work is a skilled occupation.

The ports of this country offer more than the bare facilities for discharge and loading. Many cargoes require special treatment and extensive shore installations have been built within the Customs fence. Meat, sugar, tobacco, wool, timber (hardwood, softwood and plywood) as well as a proportion of general cargo are taken from the ship to their appropriate storage places. The facilities for warehousing and the equipment employed have, in the main, been geared to meet the demands of single shift working. To integrate these essential services with a three shift system would raise difficulties, whose solution could only be found in a long term programme. For instance, reverting to softwood timber which is handled by a very limited specialist section of the register, either more deal porters would have to be attracted to the industry or the existing methods of shipping and handling altered. This would probably mean that the "closed shop" status it enjoys would have to go.

Distribution and Storage Problems

Transit sheds in their present form can be said to date from the early steam ships, which demanded a quicker turnround, and also facilities for landing and sorting much of their cargoes — much larger and more complex than those carried by the sailing vessels. As the name implies, transit sheds are not to be used for goods other than those in transit. Their number and their size may be regarded as meeting normal demands. These include occasional overtime working. To double or treble the amount of cargo landed, without increasing similarly the opportunities for disposing of it, would be to congest the shed to a degree that would quickly stop the ship from further landing. How many organisations who rely on the docks for their raw material would willingly alter their working conditions to include collections during the night hours? Could Covent Garden, to suggest one example, cope with deliveries of green fruit from the docks in London that, for two or three days, continued without any letup?

Assuming that the physical problem was solved it would still be necessary to increase the staff of Customs officers to clear the incoming cargoes. The protection of the revenue is a skilled profession to which additional officers could not easily be drafted.

Transit sheds are also used for exports in transit. Few problems, since the late war, have received more continuous attention than the attempt to regulate the flow of land-carried exports to the loading berths. The result, so far, has ensured a fairly constant stream of packages into the sheds. In turn, the loading stevedore has regulated his gang strength by the amount of cargo on the floor—with due regard to the loading ports. Before the Second World War all-night working on exports was common. It was not unusual for a shed to be emptied of cargo during the night hours. The gangs taken on for the following day worked, at first, from hand to mouth, taking the export cargo as it arrived, almost directly from the lorries. Where an import ship, working shifts, might be brought to a halt by filling the transit shed, an export ship "working round the clock" might stop because the shed was empty. Ships would then be reduced to overside working.

The sound of distant shunting referred to earlier as one of the few "noises off" that disturb the present nocturnal tranquillity is evidence of the activity both of the main line railways and the port railway system. The removal of full wagons of imports and wagons emptied of exports and the substitution of these by empty and full wagons ready for the next morning's work occupies the railway staff long after the "orderly confusion of ship discharge" has ceased for the day. A radical change in the present working conditions of both the main line and the ports' rail staff would be required, assuming that the present internal rail systems could be made to cope with the increased traffic.

The equation between the supply and demand for barges, both for general and special cargoes, is rarely solved for many days at a time. Whilst it is argued that in each port there is sufficient craft tonnage to meet normal demands it is common knowledge that craft are either scarce or in small demand, according to seasonal traffic and trade recessions. When they are hard to come by it is not uncommon to find that they are being delayed at receivers' premises. The extent of the industry's annual bill for demurrage is a measure of the use of craft as temporary warehouses. If this is the pattern of lighterage in the present working conditions it is clear that a much greater effort on the part of the receivers of lightered cargo would be necessary to maintain the flow of craft back to the ship's side. It is not easy to visualise the necessary effort being made.

Lightermen form another specialist section of transport workers. They arrive at their status only after years of training. Either their number would have to be increased to cope with shift working or their status degraded by dilution. Having regard to the high degree of skill required on a busy waterway, it is unlikely that the risks to life and property inherent in dilution would be accepted.

Wear on Premises and Equipment

How would the port authorities and the various owners view the more intensive use of their premises? Their first reaction might well be to the problem of maintenance Quay cranes, railway engines, the permanent way, all installations that contribute to the turnround of ships in port require periodical maintenance. This would become more imperative the more intense the use that was made of them. The mobile equipment owned by dock undertakings and also by some of the larger employers requires maintenance. Forklift trucks, mobile cranes, tractors etc. are, normally, withdrawn from use for this purpose, either on a time or a mileage basis. The present staff of maintenance fitters and other mechanics would hardly be adequate to deal with the more intensive use. Equipment that relies on batteries for power has to be withdrawn for recharging after a relatively short period of use. This is now done after working hours and during the night.

Although a high standard of lighting would have to be maintained for general night working, it is not expected that the supply of the additional electricity for lighting and power would present a difficulty to local authorities (5). The provision of meals after normal hours would be an urgent task; we have said that a dependable supply of hot meals would be expected during the night shift and during cold weather. The port authority, or the employer as the case may be, would be called upon to extend their catering organisation to cover shift working.

Whilst the day shift would continue to dominate the planning and would account for the bulk of the staff, both administrative and operating (both in quantity and quality), additional staff would be needed for supervisory duties on the two later shifts. Again, suitable men would have to be engaged and trained. Additional tally clerks

United Kingdom Ports and Shift Working—continued

would need to be engaged for the greater demand.

The Dockers' Viewpoint

How would shift work be received by the transport worker? The Inland Transport Committee of I.L.O., in their Report, admit that it could not fail seriously to disrupt the dockers' family and social life. The improved standard of living achieved by men on the Board's register has made possible a variety of leisure time occupations that were not open to the casual worker of an earlier generation. Would the docker willingly leave his family and the "telly" to turn out for a wet and cold shift in a dock some miles away from his home? The Overtime Ban Strike of October-November 1954 was marked by the Blue Union's plea that overtime deprived the stevedore of his legitimate opportunities for culture. How much more cogent would this argument sound if applied to the twilight and the night shifts. Again, the port worker would see the danger or irregular employment in any national alteration of his present working hours. "Working himself out of a job" would also appear as a real menace. Much war-time bombing was directed particularly at the dock areas in the larger ports, and much housing was demolished. Dock workers have tended to live farther afield. They rely largely on public transport, whose working schedules would need to be adjusted to meet the demands imposed by shift working.

What benefits could the docker expect? Principally higher payment when required to work shifts B and C. Whether his average annual earnings would then exceed those of a single shift plus the "reasonable overtime" he now works, would be difficult to predict. Where the docker's pay packet includes piecework earnings it is probable that these would not be maintained at their present level, particularly in the early days of shift working. High piecework earnings depend largely on uninterrupted working. In present conditions this has been achieved by the co-operation of the many interests centred in a port. At the best of times it is a delicate balance liable to be upset by the absence of a lighterman or the failure of documents to arrive in time. Shift working which would depend for its success on 100 per cent. co-operation from many outside interests would bear hardly on the rhythm of the piecework stroke.

Although problems posed by a complete changeover to shift working are many, let it be assumed that they have been successfully solved. What are the benefits that the country would enjoy? In the port of Liverpool where, as has been mentioned, a night shift is worked to expedite the turnround of certain ships, it has been found that ship time lost in overseas ports can be made up there. Such an advantage, in spite of the additional cost (in any case less than that of keeping the vessel in dock), cannot fail to attract shipping to the port that offers such facilities.

The high cost of maintaining both labour and staff on a basis adequate for shift work has often been advanced. The rates that would have to be charged for the services of loading and discharge under shift conditions would reflect the cost of overtime, employers increased contributions to the "fall-back," and an element for port installations. They would have to be very high indeed before they reached the present cost to the country of keeping ships idle in port.

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(4) National Dock Labour Board, Report and Accounts for 1956.
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Stabiliser Recesses in No. 6 Drydock Southampton Docks

The Trafalgar (No. 6) Dry Dock at Southampton has, since it was built in 1905 been enlarged and adapted to meet modern conditions; for instance, in 1911 it was widened to accommodate the White Star liner "Olympic" and in 1922 the dock was lengthened to take the "Berengaria." The latest adaptation has been the cutting of recesses in the side walls for the accommodation of stabiliser fins. The recesses serve essentially two purposes. The first, which will be the more frequent and regular use, is to enable the stabiliser fin to be extended while the ship is in dry dock to facilitate routine inspection and painting. For this purpose, a recess 12-ft. 6-in. wide and penetrating 7-ft. into the wall of the dock is required. These dimensions are sufficient to give reasonable space for men to work round the fin when extended.

The second purpose which is less likely to arise but presents a more complicated problem when it does, is for the removal first of the fin and then of the driving shaft if these components should require to be taken to the workshops for attention. From the point of view of handling, it would have been simpler to arrange for the fin and the shaft to be turned in a horizontal plane after withdrawal from the hull of the ship and lifted up between the ship's side and the dock wall.

To provide sufficient space for this turning operation however, would have involved cutting away the lower part of the dock wall for such a length as to endanger its stability quite seriously. The alternative solution was therefore adopted of turning the components in a vertical instead of in a horizontal plane and providing in the walls of the dock relatively narrow slots—3-ft. 6-in. wide, to accommodate the outer ends of fins and shafts as they turned. These slots rise from the back of the inspection recesses already described and run right up to the top altar, the maximum penetration into the wall from the face of the lowest altar being about 14-ft. 3-in.

As these slots form complete breaks in the altar ways along which men may require to walk when handling shores, it may be necessary to provide temporary bridges across them at the various altar levels. In view, however, of the declining use of shores in drydocking, it has been decided to await the outcome of experience before taking this step.

One of the stabiliser recesses cut in the walls of the Trafalgar Dry Dock.

The cutting of the slots and recesses into the old concrete was carried out using normal compressed air equipment, and after they had been opened to the required size the rough concrete surfaces left by the cutting were rendered over.

The first ship to make use of the facility was Orient Line's 20,700-ton "Orsova" which occupied the dry dock for nearly three weeks in March.

The work was planned and carried out under the supervision of Mr. J. H. Jellett, O.B.E., M.I.C.E., Chief Docks Engineer, Southampton.

Book Reviews

Dock and Harbour Engineering. Vol. 1: The Design of Docks, by H. F. Cornick. (Charles Griffin & Co. Ltd. Price £5 5s.).

As is advertised from time to time that such and such a screen play is the most magnificent or the most stupendous, so more occasionally one reads that a certain publication enjoys some less flamboyant distinction. The volume reviewed here is the first of a very comprehensive four- volume treatise which will no doubt become a standard work of reference for all concerned with the design, construction and operation of docks and harbours. The complete treatise provides a fuller treatment of this wide subject than does any other single work.

The layout of the volume is modern and follows the principle of emphasising points of design and guiding the reader's approach to a particular subject by means of copious illustrated examples of past and modern practice, a principle frequently successfully followed in the more comprehensive German textbooks of to-day. The Author's preface remarks that whereas there is a mass of research, experience and authoritative information existing on dock and harbour matters in papers in the proceedings of the engineering institutions and various technical journals, a great amount of time and labour must be devoted to the study of relevant data from widely different sources in order that the engineer or student can obtain a reasonably clear picture of the factors involved in any one topic or problem. The Author's intention is to relieve the port engineer of much of the necessity for the wide search of sources of information, not all of which are readily available or even known, and it is considered that the treatise goes some considerable way to achieving this object. As Mr. W. P. Shepherd-Barron writes in the Foreword to the work, the Author's selection of scientific and engineering data and information gives evidence of wide experience and judgment. That experience and judgment was otherwise known to Mr. Shepherd-Barron because Mr. Cornick has served in many positions of responsibility in the docks and estuary of the River Thames administered by the Port of London Authority.

With regard to the plan of the treatise, Volumes 1 and 2 are devoted to the design of Docks and of Harbours respectively, Volume 3 deals with Buildings and Equipment and Volume 4 treats of the Construction of both docks and harbours.

The present volume, divided into six chapters, firstly includes a succinct and interesting account of the history and development of ports and docks, then a comparative survey of various methods of port administration. The second chapter deals with the general design of docks under the headings of the siting, the form and shape of the dock, and the factors determining quay layout, together with a note on American practice in layout. The effects on port development of trends in ship sizes and design are discussed, and a particularly up-to-date and useful review of the latest trends in ship construction and their effect on ports and waterways emphasises the importance of the utmost co-operation between ship owners and port authorities, on an international basis. There follows some two dozen illustrated examples of representative dock layouts, with notes upon their history and development, and the chapter ends with an article on marine airports and seaplane bases. The general design of all types of dock and wharf walls is fully treated and well illustrated in the third chapter, which is a long one. Again, the text seeks to inform by example, and some ninety-seven illustrations of typical walls are comprehensively discussed in the text. Failures of dock walls are described but no attempt is made here to investigate the soil mechanics aspects of these failures, this subject and its influence on the design of structures, being fully dealt with in Volume 4.

Chapter 4, entitled Entrances and Locks, deals with such aspects as the siting, dimensions and arrangement of a dock entrance, the various types of entrance, the maintenance of the approach fairway and the structural features of entrances and locks, again with reference to many actual examples. Graving docks, floating docks and slipways are very fully treated in a long fifth chapter, which begins with the historical development of the craft of ship repairing. A particularly good essay upon the economic considerations involved in various types of ship-repairing docks, is included. Under the heading "Graving Docks," the distribution of pressure on keel and bilge blocks is adequately discussed from the aspect of modern design practice. Eleven examples of graving docks are illustrated and described, and the subject matter then includes discussion upon examples of floating docks and of slipways. The last chapter, dealing with lock gates and caissons, opens with an interesting account of the relative merits of caissons and gates. Numerous examples of dock gates and caissons are illustrated, and essays upon the proportions of gates, buoyancy considerations and stresses in gates (with examples of stress investigations), will be of interest to the engineer. The volume concludes with examples of modern caissons and some useful notes on the design of both floating and sliding types.

Not the least valuable part of this work is the inclusion at the end of each chapter of an up-to-date bibliography. That so large a proportion of the references are dated since the last war gives evidence of the comprehensive re-writing, modernisation and amplification of the material of Dr. Brysson Cunningham's textbooks, "Dock Engineering" and "Harbour Engineering," upon which the present treatise is based. The material as a whole is fully representative of the more important dock construction work that has been carried out up to the present time.

Code of Practice for Safety in Docks. Published by the International Labour Office in booklet form and obtainable from all I.L.O. Offices, price 6s. or U.S. $1.

The publication of this international code for safety and health in dock work, which was approved by a tripartite committee of experts in 1956, marks one of the most important achievements of the International Transport Federation for the code itself originated with proposals made by the I.T.F. Dockers' Section and approved by the 1948 Congress. These were submitted to the I.L.O. and were intended to form the basis of amendments to the I.L.O. Convention of 1932 concerning the protection of dockers against accidents. It was subsequently decided, however, to leave the Convention as it was and to supplement it with a code of practice.

The published code, covers in considerable detail a wide range of dock activities best summarized by the chapter headings: General provisions; Wharves and quays; Means of access to ships; Transport of dock workers by water; Protection of hatchways; Access to holds; Decks; Loading and unloading machinery and gear; Loading and unloading operations; Transport equipment and operations; Lifting, carrying and piling material; Warehouses and storeplaces; Dangerous substances and environments; Personal protective equipment; Medical aid and rescue; Personnel facilities; Selection and training of dock workers; Safety and health organization; Miscellaneous provisions.

The code does not comprise a set of regulations and is not binding, but it is presented as "the work of experts, embodying the knowledge and experience of many countries." Stress is laid on the need for co-operation between all the parties concerned in dock work and recommendations are made on the establishment of safety committees. Great importance, too, is attached to the provision of health and welfare facilities.

The code is to be supplemented by explanatory material in due course but this will obviously take some time as a great deal of work is involved.

Earth Pressures and Retaining Walls. By Whitney Clark Huntingdon. Published by Chapman & Hall, Ltd., London, W.C.2. 534 p.p. Price 92s.

This book is devoted entirely to the design of retaining walls and the forces to which they are subjected. It is a comprehensive and thorough treatment of every aspect of the subject; both text and diagrams are clear, and the examples are well chosen. The methods described are widely used in this country as well as in the U.S.A., and engineers confronted with unusual problems relating to retaining walls will undoubtedly find this work of considerable assistance.

Ports of the World. 12th Edition. Published by The Shipping World, Ltd., Arundel Street, London, W.C.2. Price 80s. net.

This useful volume follows the format of previous editions but has been expanded and revised to give the latest details of port accommodation, facilities, charges, names of officials, etc., throughout the world.

Flexible Steel Dolphins and Kindred Structures

Survey of Recent Developments in the Netherlands

By Ir. Tj. J. RISSELADA
(Chief Engineer of the Public Works Department of Amsterdam,
Chief of the Department of the Harbour Works.)

(Continued from page 19)

(d) Description of Completed Structures

Here too, the division will be between large structures (mainly intended for big tankers) and small structures (intended for coasters, inland craft, ferries, etc.).

Large Structures

After the first large steel dolphin, flexible in all directions, consisting of four tubular piles 28⅜-in. (721 mm.) with hinged braces had been built for "Amatex" in the Jan van Riebeeck dock at Amsterdam in 1953,§ another set of dolphins had to be built a year later for a further extension.

In the meantime Peine had developed the above mentioned polygonal piles, while Mannesmann had applied themselves to making tubes of a large diameter, manufactured from very high-tensile steel.

A comparison was made between, on the one hand, a dolphin consisting of 6 Peine piles (see Fig. 11) fitted at the top with hinged braces—the piles being joined rigidly with respect to torsion—and, on the other hand, a dolphin consisting of a tube with a diameter of 47¼-in. or alternatively of 50⅜-in. (1,200 or 1,280 mm. respectively). The comparison showed that the single tubular pile dolphins should be between 40% or 50% cheaper than the four-tubular pile type erected in 1953 and between 10% or 25% cheaper than the 6-Peine pile type (see Table I). Nevertheless, since there was some fear that there would be difficulties in driving a tube with such a large diameter, the six-pile dolphin was finally adopted. During its erection the application of cutting edges greatly facilitated driving, rendering jetting superfluous.

Rotterdam was the first to adopt such a large one-pile dolphin in practice, viz. as a structure for mooring a floating dock. A pile was chosen with a diameter of no less than 57-in. (1,450 mm.).

In the meantime at Amsterdam "Amatex" (Fig. 12) once more needed another berth for seagoing vessels in connection with its further extension. For the mooring accommodation this time one-pile dolphins were chosen (Fig. 13). The requirements were practically the same as those stipulated for the dolphins which had been built before. To increase flexibility a pile was decided on with a diameter of 39⅜-in. (1,000 mm.) and a correspondingly larger thickness of wall. The piles were driven without the aid of jetting.

For costs and further data showing the comparative figures, see Table I.

Fig. 14 represents the situation of the new works of "Niehuis and v.d. Berg" in the Eem-dock at Rotterdam.

Of the three docks, the largest—suitable for ships up to about 10,000 tons—is attached to three piles, while the intermediate and the smallest dock together, are moored to two piles. The attachments consist of jibs sliding along the piles. Along the part above the bottom of the dock of the two piles to which the two docks are moored, a steel tube was welded on so that the jibs of both docks can function independently of one another (Fig. 15). The

§ See "Dock and Harbour Authority," June, 1954

Fig. 11. Flexible steel dolphin of the "Amatex" berth E at Amsterdam.

TABLE I

Per dolphin	Unit	Amatex berth (see Fig. 12)				
		I	E	E_1	E_2	II
Type of pile		Mann tube	Peine	Mann tube	Mann tube	Mann tube
Section/diameter	ins.	28⅜	PSp 50S/70	47¼	50⅜	39⅜
	(mm)	(721)	+4 PSpwl20	(1200)	(1280)	(1000)
Number		4	6	1	1	1
Thickness of wall (max.) ...	ins.	15/16	—	1¾	1 3/16	2 3/16
	(mm)	(24)	—	(44)	(30)	(55)
Yield stress (of part with the highest grade of steel) ...	tons/ sq. inch	28.6	22.7	28.6	28.6	28.6
	(kos./sq.cm.)	(4500)	(3600)	(4500)	(4500)	(4500)
Length (max.)	ft.	98	93	105	102	103
	(m)	(30)	(28.35)	(32)	(31.2)	(31.25)
Weight of piles	tons	4 × 10	6 × 10	35	26	32
Energy-absorption	ft. tons	115	96.4	131	99	126
	(mt)	(35)	(29.4)	(40)	(30.2)	(38.3)
Max. moment	ft. tons	5220	6400	6580	5310	5430
	(mt)	(1591)	(1950)	(2005)	(1619)	(1648)
f/P	ins./t	0.28	0.209	0.200	0.232	0.291
	(cm/t)	(0.71)	(0.53)	(0.51)	(0.59)	(0.74)
Static load at 3′ 6″ (3.2m) above water level ...	tons	80	101	98	80	80
Depth of water	ft.	43	43	43	43	43
	(m)	(13)	(13)	(13)	(13)	(13)
Approximate total cost (basis Jan., 1955)	£	10.200	6.800	6.200	5.100	5.900

Flexible Steel Dolphins—continued

dimensions of the piles are calculated so as to resist the static forces imposed on them by the docks (as a result of wind). See Table II.

Furthermore a dolphin is placed near each jetty for the securing of the rear hawsers of the ships to be moored there. These dolphins are calculated so as to withstand a pull in the hawser of 60 to 80 tons and they consist of four Peine piles comprised of a section PSp 50S/70 plus 4 PSpw 120 (see Fig. 5). Since resilience is not required for this structure the top bracing was welded direct on to the piles.

Another application of tubular piles is to be met with in the one-pile dolphins of the "Tankercleaning Ltd." in the Wilhelmina dock at Schiedam, the data of which are as shown in Table III.

The most recent application of tubes for large dolphins can be found at Amsterdam, where on behalf of the recently established tanker-cleaning works of the "Nederlandsche Dok- en Scheepsbouw Maatschappij" two dolphins have been erected each consisting of two piles ϕ $39\frac{3}{8}$-in. (1,000 mm.) rigidly jointed by two bracings (see Fig. 16).

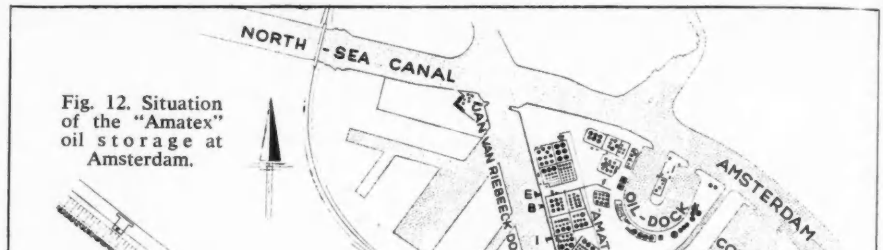


Fig. 12. Situation of the "Amatex" oil storage at Amsterdam.

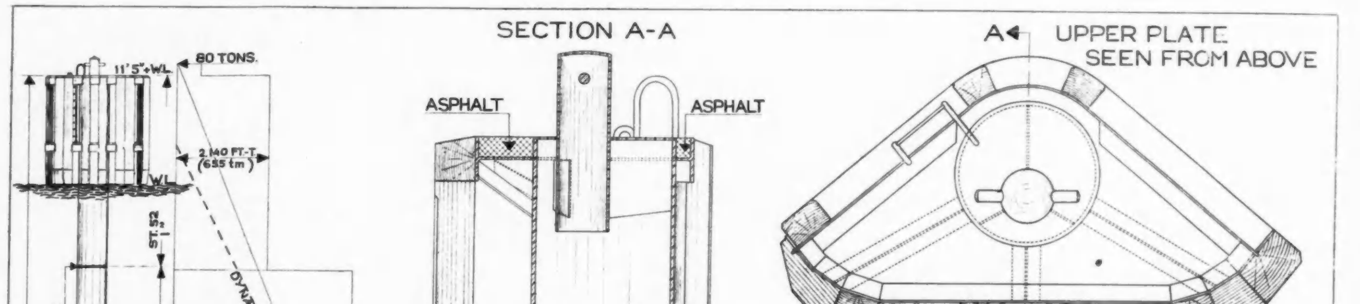


Fig. 13.

Flexible Steel Dolphins—continued

TABLE II

Per pile (single tube)	Unit	Dock A	Dock B
Type of pile ...		Mann tube	Mann tube
Diameter	ins. (mm)	57 (1450)	49 3/16 (1250)
Thickness of wall (max.)	ins. (mm)	1 3/8 (35)	1 3/16 (30)
Yield stress (of part with the highest grade of steel) ...	tons/sq.inch (kos./sq.cm.	28.6 (4500)	28.6 (4500)
Length	ft. (m)	107 (32.7)	100 (30.4)
Weight of piles ...	tons	35	23
Max. moment ...	ft. tons (mt)	7930 (2418)	5050 (1541)
Static load at 16′ 5″ (5m) + N.A.P.[1]) ...	tons	102	67.5
Depth of water (—N.A.P.[1]) ...	ft. (m)	43 (13)	33 (10)
Angle of internal friction down to 57′ 5″ (17.5m) —N.A.P.[1])	degree	0	0
below 57′ 5″ (17.5m) —N.A.P.[1]) ...	degree	30	30

[1]) N.A.P. = Normal Amsterdam Level.

As a result of that bracing being rigid with respect to torsion, both piles come into action when eccentric impacts occur. In this case the second pile supplies about 60% of the energy which a detached pile would supply if the deflection were the same as that of the braced pile.

It seems worth mentioning that there are

TABLE III

Per dolphin	
Type of pile	Mann tube
Diameter	45¼″ (1150 mm)
Thickness of wall (max.) ...	1 7/16″ (36 mm)
Yield stress (of part with the highest grade of steel) ...	28.6 tons/sq. inch 4500 kos./sq.cm.
Length	90′ (27.5 m)
Weight of pile	22 tons
Energy—absorption ...	96.4 ft. tons 29.4 mt
Max. moment	5020 ft. tons (1531 mt)
f/P	0.161 ins./t 0.41 cm./t
Static load at 13ft. 2 in. (4m) + N.A.P. (Normal Amsterdam Level)	89.7 tons
Depth of water below N.A.P.	59 ft. (18 m)
Angle of internal friction ...	20 degrees

plans to erect very soon the largest one-pile dolphin so far built at Amsterdam. It is intended for mooring ships which are under trial.

This pile has a ϕ of 72-in. (1,830 mm.); the thickness of its wall is max. 1 11/16-in. (43 mm.) and its weight 40 tons; it has to be driven into 49-ft. (15 m.) of sandy soil. It cannot be hoped to accomplish this without the aid of jetting and it is probable that jetting pipes welded on to the inside will be used.

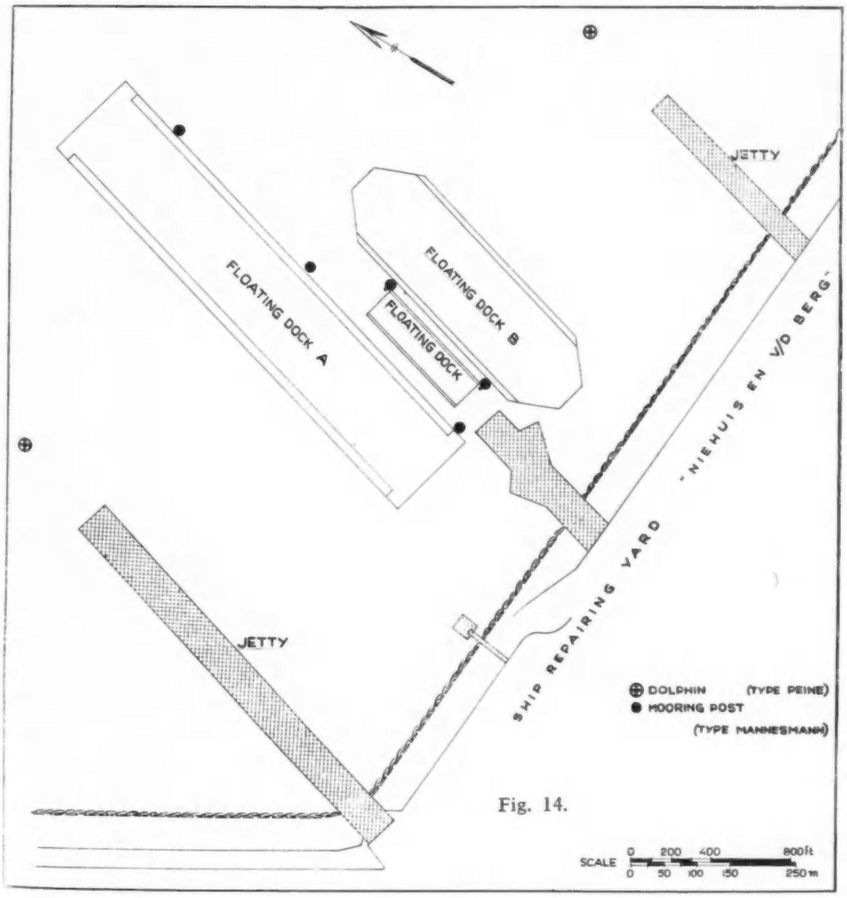


Fig. 14.

The wide flange-sections are utilised in dolphins erected for the "B.P." at Pernis and at Amsterdam. 7, resp. 5 sections have been made use of (see Fig. 17).

Likewise wide flange-sections were employed for a set of dolphins for the "Hollandsche Olieseparator Maatschappij" at Amsterdam. The sections are placed in two rows behind each other with hinged connections at two places (see Fig. 18).

Further details may be found in Table IV.

Small Structures

First, those dolphins will be considered which are employed for smaller ships having to be berthed at deep sea berths. This is the case for instance with the berths in the Jan van Riebeeck dock at Amsterdam, the large dolphins of which have already been described. Characteristic of such

Fig. 15. Mooring post for two floating docks near the ship repairing yard "Niehuis and v. d. Berg" at Rotterdam.

structures is the great depth of water prescribed by their circumstances, the great depth in itself making great flexibility possible.

These small dolphins show a development analogous to that of the large ones alongside them; the sizes and the number of piles, however, are smaller. The data and the cost are given in Table V.

An example of the small dolphin erected in more appropriate circumstances is the type that was built in several places (e.g. in the Jan van Riebeeck dock at Amsterdam near the previously mentioned Amatex and the new power station).

It is worth mentioning that some piles are provided with a vertical rubber fender, to give the ships a still softer berth (see Fig. 19).

An instance of broad dolphins, such as described for the mooring of tankers at the N.D.S.M., can be found in a smaller size

Flexible Steel Dolphins—continued

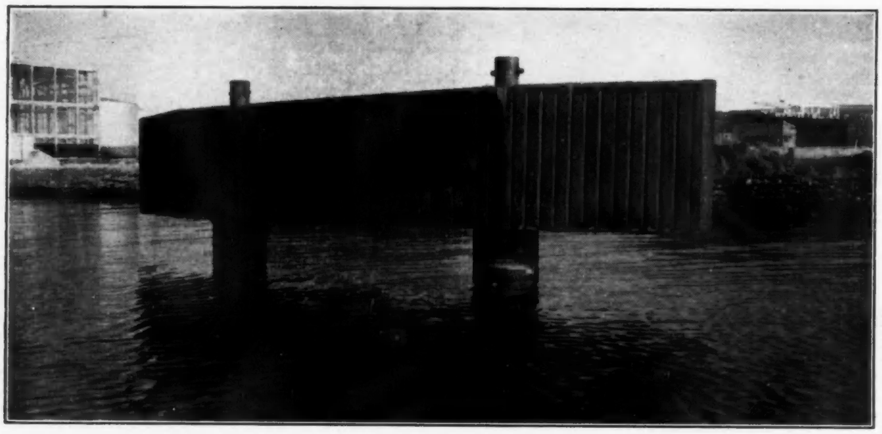


Fig. 16.

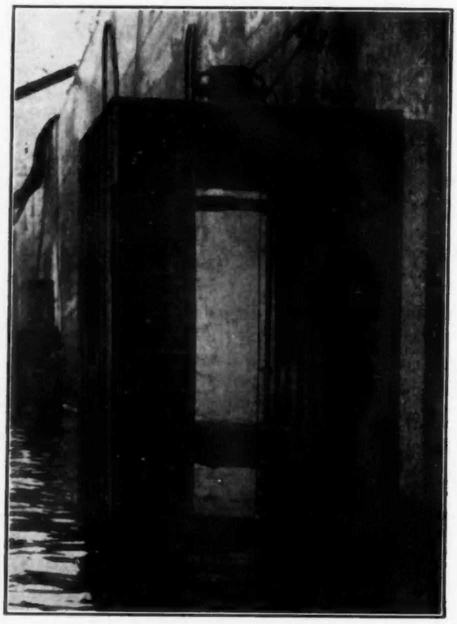
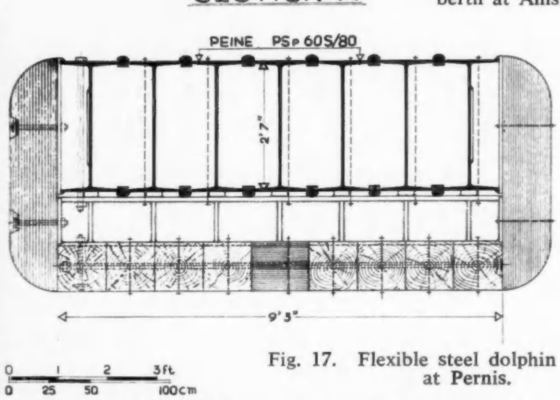


Fig. 18.

Fig. 16 (left). Flexible steel dolphin of the N.D.S.M. at Amsterdam.

Fig. 18 (bottom left). Flexible steel dolphin of the H.O.M. berth at Amsterdam.



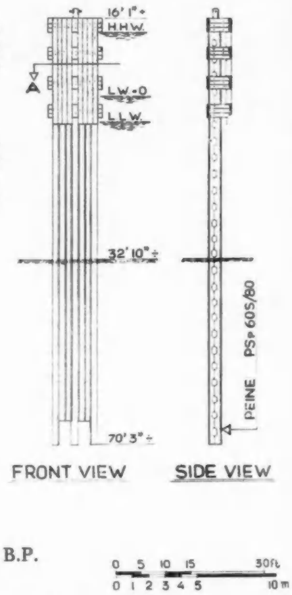


Fig. 17. Flexible steel dolphin of the B.P. at Pernis.

in front of the heads of the jetties for the ferry-launches of the port. Initially a rigid, wooden structure had been planned here, intended merely as a protection of the jetty; by using steel tubes, however, the structure could be given the necessary flexibility, so that berthing can be easier and takes less time (see Fig. 20).

For a new ferry across the IJ at Amsterdam a set of lead-in jetties—actually twin-sets—had to be erected (Fig. 21). They consist of two side fenders, an intermediate one and two terminal ones. On the basis of the encouraging experience with resilient structures gained elsewhere, here the more rigid structures formerly employed were abandoned and resilient structures were chosen. These fenders may be regarded as long-drawn-out dolphins or as mooring-walls.

Like the structures described above, the side and intermediate fenders are made from Mannesmann-tubes of ϕ $21\frac{1}{2}$-in. (546 mm.) joined by two girders. Since relative to the length thereof the lateral movement of the piles was only very small, there was little or no advantage in the connections being rigid with respect to torsion.

The girders have to spread the impacts over the piles as well as to bear the facing of hardwood. The place of the piles has

TABLE IV (below). TABLE V (right).

Per dolphin	Unit	H.O.M. Amsterdam	B.P. Amsterdam	B.P. Pernis
Type of pile		Peine	Peine	Peine
Number		2 × 6	5	7
Section		PSp60S	PSp60S/80	PSp60S/80
Yield stress (of part with the highest grade of steel)	tons/sq.inch (kos./sq.cm.)	22.7 (3600)	22.7 (3600)	22.7 (3600)
Length (max.)	ft. (m)	81 (24.8)	82 (25)	86 (26.3)
Weight of pile (pair of piles)	tons	abt. 10	abt. 10	abt. 10
Energy—absorption ...	ft. tons (mt)	229 (69.8)	92.5 (28.2)	85.9 (26.2)
Max. moment	ft. tons (mt)	8020 (2445)	4760 (1450)	5940 (1811)
f/P	ins./ft. (cm/t)	0.157 (0.4)	0.193 (0.49)	0.205 (0.52)
Static load ⊥ bank at 10 ft. (3m) above water level	tons	83	85	100 at 13 ft. (4m) above H.W.
Depth of water	ft. (m)	32 (9.7)	33 (10)	from 28 to 46 (from 8,5 to 14)
Angle of internal friction	degree	20	25	30

Per dolphin	Unit	Amatex		
		I	E	II
Type of pile		Mann tube	Peine	Mann tube
Section/diameter ...	ins. (mm)	$20\frac{1}{2}$ (521)	PSt.120	$30\frac{11}{16}$ (780)
Number		3	3	1
Thickness of wall (max.)	ins. (mm)	$\frac{9}{16}$ (14)	1 (25)	$\frac{5}{8}$ (16)
Yield stress (of part with the highest grade of steel)	tons/ sq.inch (kos./sq.cm.)	29.2 (4600)	22.7 (3600)	28.6 (4500)
Length	ft. (m)	85 (26)	79 (24)	83 (25.2)
Weight of piles	tons	3 × 4.5	3 × 5	7.8
Energy—absorption ...	ft. tons (mt)	**24.6** **(7.5)**	**33.46** **(10.2)**	**27.55** **(8.4)**
Max. moment	ft. tons (mt)	1191 (363)	1164 (355)	1184 (361)
f/P	ins./t. (cm/t)	1.614 (4.1)	1.555 (3.95)	1.098 (2.79)
Static load at abt. 7′ (2m) above water level ...	tons	20	20	20
Depth of water	ft. (m)	43 (13)	43 (13)	43 (13)
Angle of internal friction	degree	20	25/30	25/30
Approximate total cost (basis Jan., 1955) ...	£	2000	1800	1420

Flexible Steel Dolphins—continued

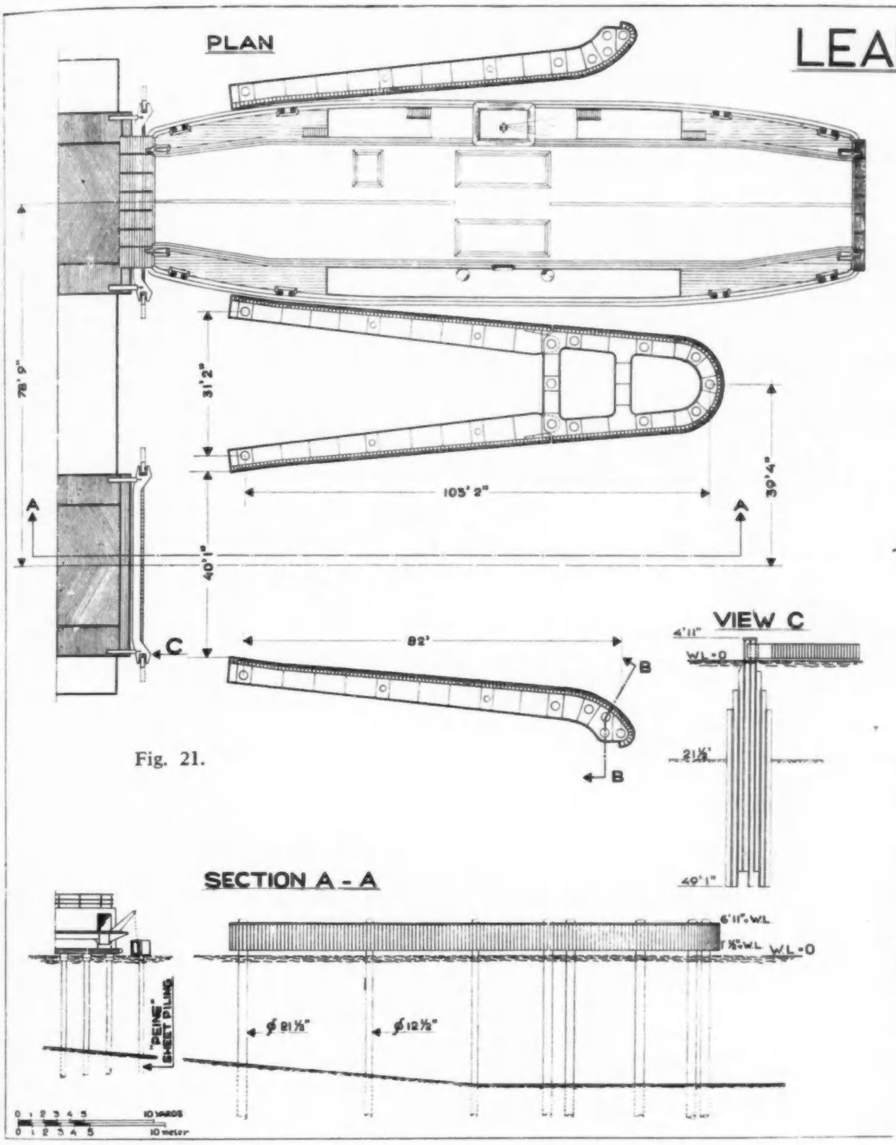
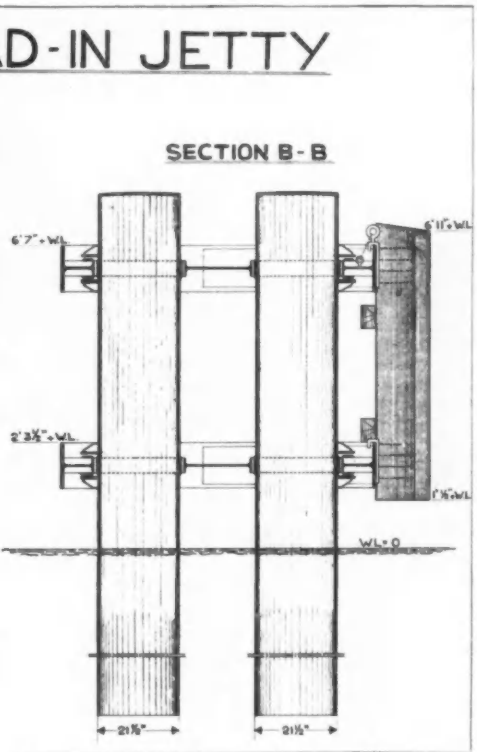



Fig. 21.

Fig. 19. Dolphin with rubber fender for inland craft.

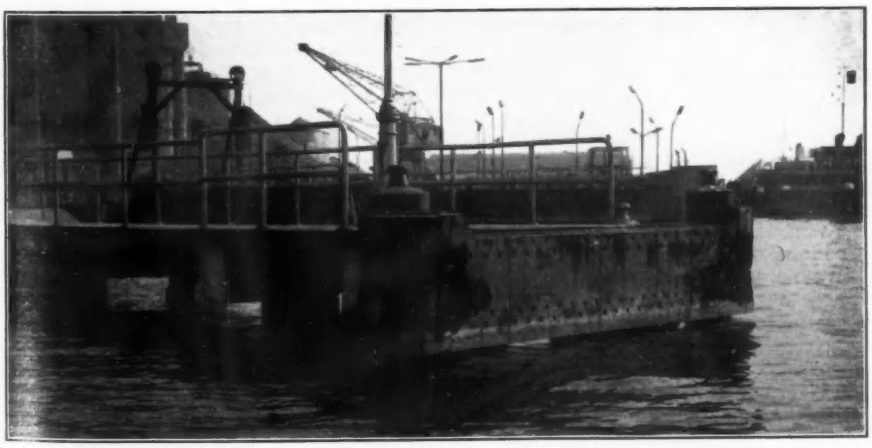


Fig. 20. Two-pile dolphin in front of a jetty for ferry-launches.

been determined so as to distribute the load as equally as possible.

The largest number of piles have been placed at the heads of the lead-in jetties, the most vulnerable places, since any collisions by the ferry boats will take place there, not only with the relatively greatest speed but also at the most unfavourable angle. The intermediate piles ϕ 12½-in. (318 mm.) only, are provided just for the support of the girders and do not contribute essentially to the absorption of energy.

To prevent a ferry-boat berthed on one side of the intermediate fender being affected by a ferry boat hitting that fender when berthing on the other side, the girders of this fender are fitted with hinges just behind its head, in consequence the

Flexible Steel Dolphins—continued

movement of the parts of that fender behind the hinges is greatly reduced.

The terminal fender, against which the ferry boat finally runs with its head foremost, should be able to absorb the remaining energy without the blow getting too excessive. The permissible deflection is reduced to 22-in. (0.56 m.), to suit the construction of the ferry boats. This fender consists of a heavy box plate girder situated partially under the hinged bridge in the front part of the landing stage and leaning at its ends against two flexible steel dolphins. Since the girder, in order to be movable, has necessarily to be underneath the hinged bridge and must not be in the water because of the danger of getting frozen in, its height is very much restricted. In order to enable the girder nonetheless to fulfil its task, at all levels of the water and of the deck of the ferry boat, it has to be movable vertically; with that end in view it has been hung from the adjustable hinged bridge of the landing stage, with which it can, consequently, move up and down.

The lead-in jetties are calculated for ferry-boats with displacements of about 700 tons. For the terminal fenders an impact applied eccentrically with a berthing speed of 2½ ft./sec. (0.75 m/sec.) is assumed so that one dolphin must be able to absorb 85% of the energy of 65.6 ft. tons (20 metre-tons) present in the ferry boat.

Each dolphin consists of 8 sheet piles PSp 30, the lengths of which are such that the cross-sections of the structure at various levels are adapted to the max. moments at those levels (see Fig. 21, view C).

TABLE VI

	Unit	Side fender	Intermediate fender	Terminal fender
Type of pile		Mann tube	Mann tube	Peine
Number and diameter ...	ins. (mm)	6⌀ 21½ + 2⌀ 12½ (6⌀ 546 + 2⌀ 318)	9⌀ 21½ + 4⌀ 12½ (9⌀ 546 + 4⌀ 318)	
Number and section				8 PSp 30S
Thickness of wall (max.) ...	ins. (mm)	⅝ (16)	⅝ (16)	—
Yield stress (of part with the highest grade of steel) ...	tons/ sq.inch (kos./sq.cm.)	35.7 (5630)	35.7 (5630)	22.7 (3600)
Weight of pile (max.) ...	tons	abt. 4	abt. 4	—
Angle of collision with axis of lead in jetty	degree	30	45	0
Energy-absorption	ft. tons (mt.)	118 (36)	115 (35)	64.3 (19.6)
Deflection (max.) in direction of impact	ins. (m)	24 13/16 (0.63)	30 5/16 (0.77)	27 9/16 (0.70)

The lead-in fenders are calculated for a berthing velocity of about 3-ft./sec. (1 m./sec.), assuming impacts at an angle of 45° with the axis of the lead-in jetties for the intermediate fender and at an angle of 30° for the side fenders (see Table VI).

The equipment of the tideless port of Amsterdam also contains the light-beacons, which, together with buoys and other objects, denote the boundaries of the channels. Every now and again a ship collides with one of those exposed beacons, which until recently consisted of a number of rigidly connected wooden piles with a light on top of them. This, as a rule, resulted in the total loss of the structure. Now a steel tube ⌀ 20½-in. (521 mm.) is used, which, because of its resilience absorbs far more energy and, moreover, has more chance of gliding along a side of the ship. Experience has shown that there is much less damage, while in the worst case, should the structure of the beacon have been run askew, it takes little trouble to pull it straight.

In the Jan van Riebeeck dock at Amsterdam a fender frame has been placed next a jetty of the Amatex to safeguard the oil-pipes lying on the jetty against collisions by inland craft mooring in the immediate neighbourhood (see Fig. 12). This fender frame consists of two heavy steel girders, supported on three flexible steel dolphins.

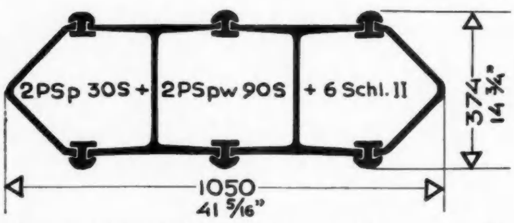


Fig. 22. Cross-section of the flexible steel dolphins of the fender frame near the "Amatex" berth II at Amsterdam.

The cross-section of those dolphins is given in Fig. 22.

The same sections (2 PSp 30 plus 2 PSpw 90) have also been used for a number of dolphins placed near a landing-stage for inland craft of the electric power station at Harculo.

A hexagonal Peine-section (PSt 120) has been used for dolphins near a landing stage for inland craft in the harbour of Hardinxveld. *(To be continued)*

Personalia

Sir Brian Robertson, chairman of the British Transport Commission since 1953, has been reappointed for a further term by the Minister of Transport, **Mr. Harold Watkinson.** Sir Brian's term of office was due to expire on September 14, but it is now understood his appointment will last a further five years.

The Mersey Docks and Harbour Board last month appointed **Mr. J. D. J. Saner, M.C., M.I.C.E.,** to be their Engineer-in-Chief.

Mr. Saner was first appointed on the New Works Staff of the Board in March, 1922, having served his pupillage with the then Engineer-in-Chief. Closely associated with the construction of the Gladstone System of Docks and later responsible for the Board's Birkenhead Estate, he was appointed an Assistant to the Engineer-in-Chief in November, 1941, and eight years later promoted to be Principal Assistant.

Mr. Saner has been associated in all the major works of reconstruction undertaken since the war in the Port of Liverpool and with the many problems arising in connection with the general maintenance of the Board's large estate and with the Oil Installations at Dingle. He has maintained close personal relationships with the various employees engaged in the Board's Undertaking and has an extensive knowledge of the many problems facing such a diversified labour force, consisting as it does of some 27 different trades.

Mr. W. A. Matheson, M.I.C.E., M.I.Mech.E. has been appointed principal assistant engineer-in-chief to the Mersey Docks and Harbour Board, filling the position rendered vacant by the promotion of Mr. Saner. From October, 1947, to July, 1957, he was engineer-in-chief with the Bristol Port Authority, leaving that position to go as assistant engineer-in-chief with the Mersey Docks and Harbour Board.

British Transport Docks have appointed **Mr. Kenneth D'Alby, M.B.E.,** Assistant Dock Superintendent at Middlesbrough Docks, to be Docks Manager at Barrow and Silloth. He succeeds Mr. J. G. Thomas who died on April 17.

Mr. D'Alby has had long experience in port operations, having commenced employment in 1927 with the firm of Messrs. D'Alby and Son, Master Stevedores at Hartlepools Docks. In September, 1955, he was appointed Stevedoring Officer at Hartlepools Docks by British Transport Docks, and in July, 1957, Assistant Dock Superintendent, Middlesbrough Docks. Mr. D'Alby served with the Royal Engineers from 1939 to 1946, and from 1948 until the present time he has been a member of the Army Emergency Reserve, holding the rank of Major. During his wartime service he was Company Commander, No. 4 Dock Group, R.E., and acted as Assistant Dock Superintendent, Palestine and Syria. He was caled up during the Suez crisis and was the Shipping Superintendent for the Operation, being awarded the M.B.E. for his services.

Modern Dry Docks: Design, Construction and Equipment

VIII Electricity and Electrical Installations

By T. DUNWOODY (Consulting Engineer)

IN common with all other activities, the Dry Dock makes an increasing demand for the use of electricity. Its application is now widespread and is embraced in practically all dock operations.

In order to appreciate the extent to which electricity is now used, it is appropriate to examine the various main aspects of Dry Dock procedure in which electricity plays an important part.

Such an examination of the electrical services needed, will indicate that there are five broad categories into which they can be separated.

(i) Electricity supply and main switchgear
(ii) Dockside activities including lighting
(iii) Repair shops
(iv) Ships' supplies
(v) Offices and administration.

These classifications are somewhat arbitrary and the categories are in any event bound to overlap, but there are characteristics in each category which are distinctive.

Electricity Supply

In the United Kingdom two methods of obtaining electricity are possible.

(i) Generation by means of privately owned plant.
(ii) From the local Electricity Board or Supply Authority.

It can be considered that in normal circumstances the private generation of electricity will not commend itself as practicable, but it is conceivable that occasions could arise where local peculiarities might have some influence on this particular matter.

Such peculiarities are however very rare, and as a generalisation it may be said that the generation of electricity and its attendant problems may well be left to the authorised undertakings, who will be able to cope with them much more economically than the private user.

Factors affecting the method of supply of electricity from an external source are:—

(i) The load requirements
(ii) The characteristics of the supply itself
(iii) The physical size of the dock area.

The responsibility for the method of furnishing the supply is vested in the Supply Authority, although the consumer almost inevitably pays the capital cost of furnishing it.

The electricity requirements of a dock are fairly heavy, and the average demand is found to be in the order of 600 kilowatts per dock, although with modern projects dealing with large vessels this may prove to be higher.

For a new undertaking, the Supply Authority will normally wish to provide a high voltage alternating current supply, as this represents, to them, the most economical form of electricity distribution.

The supply network is usually laid out on a "ring" principle, which means in effect that two main cables are brought into the premises so that electricity could be furnished by alternative routes if need be.

If such a supply be given, too much confidence should not be placed in these alternatives as standbys to one another.

In the event of a major network failure it is almost certain that all supplies, by whatever route, will cease.

Happily such a state of affairs is relatively unusual. Supply breakdowns are more often due to the failure of some particular piece of equipment or cable in the local high voltage network, which means that the alternative supply, if the facility exists, could be made available very quickly.

The speed of restoration of supply in the event of a local failure of this nature depends largely on the switching and protective arrangements adopted by the Supply Authority, and this and other relevant matters should be discussed in detail with the Authority when arrangements for a new Electricity Supply are negotiated.

In all but the very largest schemes the supply will be given at one point, and it will be at this point that the main control gear, meters, etc., are situated. The layout of the control gear will be determined by the conditions laid down for furnishing the supply, and the internal distribution within the dock area.

View of dockside pillar type connection units.

The location of the supply point, or intake position as it is usually known, will be determined by two factors:—

(i) The anxiety of the Supply Authority to terminate their cables as near to the site boundary as possible
(ii) The need to locate the main controls as near to the electrical "centre of gravity" of the site as circumstances will permit.

Main Switchgear

Room has to be found for the Supply Authority's switchgear, transformers, and the consumers' controls. These should be preferably housed in a self-contained suite, of sound construction, well ventilated and dry, and arranged in full compliance with the Regulations imposed under the Factories Acts and other statutory ordinances.

There should be a good road approach to the switchroom suite to enable transformers and heavy items of switchgear to be offloaded, close to the building, when changes of equipment are

Modern Dry Docks—continued

necessary. Provision should be made to enable lifting tackle to be used to deposit the equipment at its final position.

There is much to be said for combining the electricity intake, main switchroom, electrical conversion apparatus, and electrical maintenance workshops, under one roof in the interests of efficiency and economy in administration.

The ownership of the transformers and high voltage switchgear is usually determined by the supply agreement.

Under this agreement, the equipment may be vested in the Supply Authority or the consumer.

These matters are determined on the merits of each individual case, but it may be safely assumed in any event, that a contribution towards the capital cost of any new equipment will have to be met by the consumer.

In order to provide economic operation, and to some extent standby facilities as previously described, it is often desirable to tariff of some kind or another to be adopted. This is sometimes a "maximum demand tariff" or alternatively a "block tariff" is often proposed. This type of tariff is based on a diminishing charge per unit as consumption increases.

Whatever the method of distribution, with a maximum demand tariff it is normally to the consumers' advantage to have one metering point only; or to have "summation" metering, so that full advantage is taken of the fact that individual peaks caused by the various dock activities, do not occur co-incidentally, or, in other words, the highest maximum demand recorded is usually much less than the arithmetic sum of the maximum demands recorded on the various sections of the installation.

It is also in the consumer's interest to have duplicate meters, and if possible the Electricity Authority should be asked to provide them. If they do, the mean reading of the two meters is taken as the basis for charging for electricity consumption.

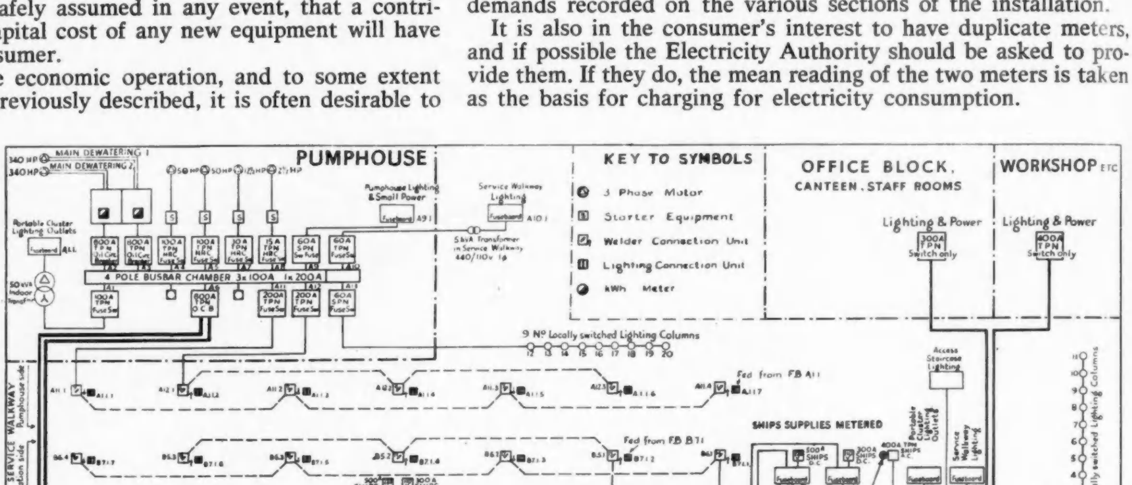


Fig. 1. Typical Main Lay-out of Electricity Distribution System.

install more than one transformer. These can then be used singly or in parallel as circumstances warrant.

Transformer losses can be high in relation to the load carried, and if the installation is metered on the high voltage side these losses are borne by the consumer.

It is thus customary to arrange for the electrical load to be so split that the individual transformers can work to a reasonably full capacity, keeping one out of circuit unless load conditions call for it. In this way maximum efficiency is achieved.

In a very large installation it may be necessary to have more than one transformer suite, especially if long runs of cable are involved.

It is economic in these circumstances to instal high voltage feeders as they require less copper than medium voltage distributors; and then to provide relatively small transformers at strategic points.

In this case, a central high voltage switchroom will be required. The characteristics of this method of distribution involves special consideration of network planning and is rather outside the scope of an article on Dry Docks.

Meters and Tariffs

At one time, lighting, heating, and power consumption, were metered separately, because separate tariffs were then generally in force for these uses. The modern custom is for an "all-in"

If the consumer provides the duplicate meters these are then read as a check on those fitted by the Supply Authority.

Most tariffs impose some restriction on power-factor when alternating current is supplied, as a poor power factor can cause material and unnecessary loss to the Supply Authority. A maximum demand tariff based on kilo-volt-amperes instead of kilowatts also penalises the consumer if the power factor is low.

Much of the electrical apparatus in use in a dock has an inherently low power factor. This is overcome, usually by the installation of power factor correction capacitors, either located adjacent to the apparatus or by providing group correction with manual or automatic control at the source of supply.

These considerations have an effect on the design and layout of the switchgear and distribution.

In addition separate sections of the installation are often required to be separately metered by the consumer, as the cost of electricity consumed in various activities is charged to the customer or the dock owner.

The actual segregation of the controls is thus further governed by individual circumstances.

It is usually desirable to provide sub-switchboards adjacent to the main electrical load centres.

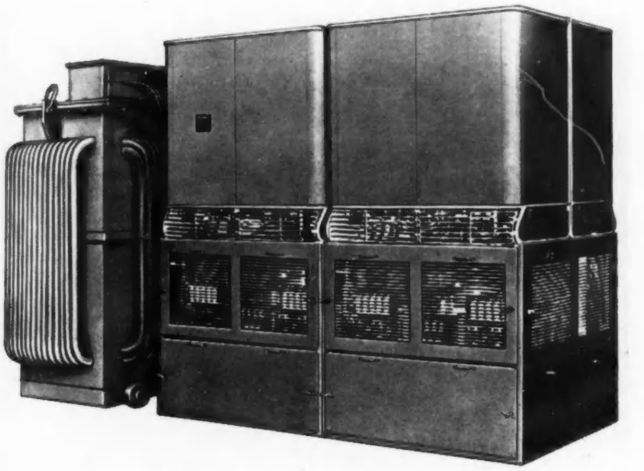
A typical main layout as illustrated in Fig. 1 shows the incoming and outgoing high voltage feeders and high tension switching arrangements. Similarly alternative medium voltage feeder cables,

Modern Dry Docks - *continued*

one from each transformer, to the main switchboard, are indicated.

The main control switchgear on both high voltage and medium voltage side is electrically interlocked and tripped so that there is no risk of injury to staff in the operation of the switchgear under fault conditions.

In certain installations relay protection is provided on thc high voltage feeders to ensure that in the event of a fault occurring



A typical 500 kw. Hewittic rectifier as used for dockyard D.C. supply

on one feeder, the clear feeder is maintained in circuit. The type used depends on local network conditions.

The main controls are separated in the following manner:—

(i) Pumps and ancillary power services and pumphouse lighting
(ii) Dockside power and ships' supplies
(iii) Crane supply
(iv) Compressors and ancillary cooling apparatus
(v) Office block power and lighting supply
(vi) Workshop power and lighting supply
(vii) Power factor correction
(viii) Spare.

It will be noted that the installation has been segregated into fairly large and rather arbitrary blocks of load, and that the installation is further subdivided at local switchboards.

At these latter points the lighting and power services are separated, as it is considered that there is considerable advantage in being able to operate lighting for maintenance purposes, etc., whilst the power installation in any area is switched off.

Although not shown on this diagram a pilot lighting system controlled and fed from the main switchboard is very desirable, as this ensures that lighting can be provided at all vulnerable points whilst the local switchboards are completely isolated.

Such recording instruments that convey useful information are incorporated in the main switchboard, although these again are not shown diagrammatically.

These usually comprise voltmeter, ammeter, and power factor indicator, with possibly an earth leakage current indicator, maximum demand alarm and similar devices.

It is felt that graphic recording instruments do not normally serve any useful purpose.

Submain Distribution

The main cables between the main control point and the submain switchboards are in most cases laid underground.

Overhead distribution is cheaper, but has disadvantages, particularly the risk of damage to the conductors by cranes, and other lifting appliances.

There is conceivably use for an overhead system linking buildings away from the dock area, but if installed these lines should not obstruct any route normally used by travelling cranes, etc.

Overhead lines need more maintenance than underground cables, properly installed.

Paper insulated, lead covered, steel tape armoured and served underground cables have proved to be eminently satisfactory in service. It is always desirable to check the characteristics of the soil to ensure that nothing is contained therein that is detrimental to the cables, or that subsidence in made up ground if cables are laid therein will not cause trouble.

On occasion, cables have to cross the dock itself. These are then carried in culverts or ducts, and as these are normally filled with water, they have to be specially treated. Double armouring and double serving at least are called for in these cases.

Dockside Installations

The electrical services at the dockside comprise basically, the provision of suitable outlets to which portable apparatus can be connected, as well as services to electrically operated winches, cranes, etc.

Outlets are needed for the connection of ships' loads, welding equipment, and portable tools, etc.

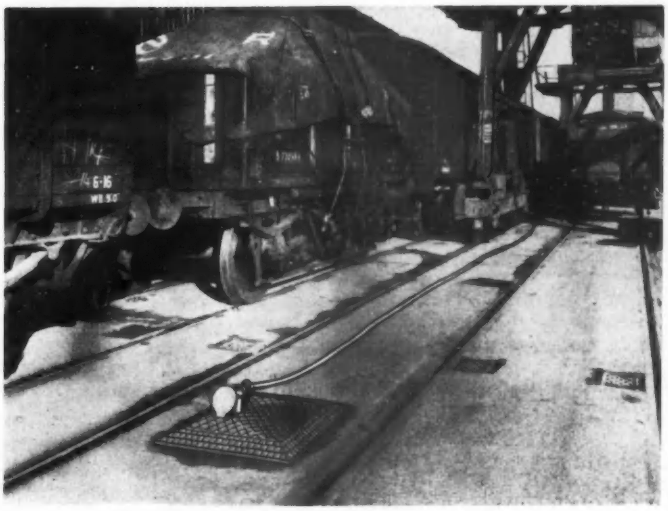
The design of these outlets needs considerable care, especially as heavy currents in some instances are dealt with. They must be completely foolproof, and watertight.

It should never be possible to break any connection whilst it is on load, and this means that each outlet should be switched, and that interlocks must be provided to ensure that the switch is always at the "off" position before the connection is made or broken.

The type of outlet used also depends on the dock construction.

Should there be an underground subway or service duct parallel to the dock, some of the outlets can be provided therein, and thus gain the advantage of the maximum possible protection against mechanical damage and weather.

Such outlets would be those to which connections would be made relatively infrequently.



View of out-door type plug connected to crane.

Many of a docked ship's services must be maintained whilst the ship's generators are shut down. The majority of these services are electrically operated and as the characteristics of ships' supplies vary considerably, outlets have to be provided at the dock side to cater for at least those that are frequently encountered; some of which are as under.

433/250 volt, 3 phase, 50 cycles per second, 4 wire alternating current.
110 volt direct current.
220 volt direct current.
380 volt 3 phase 60 cycles per second 4 wire alternating current.

The majority of the ships at present are arranged for either

Modern Dry Docks—continued

110 volt D.C. or 220 volt D.C. or both, in the case of certain tankers, and a maximum capacity of 300 amperes and 500 amperes respectively to maintain essential services is to be expected at this juncture, although again these loadings vary in accordance with the size and age of the ship, and are in any event tending to increase.

Newly built ships are mostly provided with an alternating current installation and this could vary in range from 380 volts to 433 volts, at a frequency of either 50 or 60 cycles per second, depending on the country of origin. Modern ships use electricity for deck cranes, compressors, hoists, lifts, ventilation and air conditioning apparatus amongst other applications.

The ships' loads could be thus quite heavy, and the method of connection of the ship supply cables has to be very carefully considered. As mentioned, it is normal to provide a switched connection point so that the connections are not live when the cover is removed. This may be achieved by a mechanical interlock arrangement attached to the switch handle, ensuring that the cover can anly be removed when the switch is itself in the open position.

The connection point for ships' loads could conveniently be placed in a service walk-way.

Direct current for ships' supplies may be obtained by rectifiers or rotary converters, when the main supply is alternating current, or, independently driven generators. The most satisfactory way to deal with the ships' loads normally encountered is to provide rectifiers at fixed positions.

These rectifiers may be of the mercury arc type and need to be substantial and of simple design. Mercury arc rectifiers may be either of the glass bulb or steel tank type.

There have been many advances in recent times in rectifier design. The "ignitron" is a development of the mercury arc rectifier and gives precise control under certain varying load conditions. The selenium rectifier, a type of metal rectifier, is also available, and other developments are taking place in this field.

The choice of the type of rectifier will depend ultimately on the actual load conditions, relationship of the rectifier to outlets, and, of course, on atmospheric conditions.

The less frequently required D.C. services can be met by the use of either portable rectifiers, or mobile generators, capable of giving variable voltages. It is often possible for the latter to be hired for specific occasions when only an occasional demand has to be met. Similarly, portable or mobile apparatus can be used for non-standard A.C. supplies should these be required.

Although the use of alternating current for ships' loads is increasing, it is a safe assumption that direct current will be encountered for many years to come.

Welder Outlets

Provision for dockside welding can be made by two methods:—

One is the use of single or three phase switched socket outlets at the dockside to feed mobile welder units of the multi-operator type. Experience has shown that these outlets should be rated at approximately 200 amperes each and should not be more than 100-ft. apart on both sides of the dock. The other method worthy of consideration, where a suitable service subway exists, is to provide a fixed welding transformer of suitable size in the service subway and to run from that point low voltage welding circuits to convenient outlets on the dockside.

More outlets would of course be required in these circumstances, and the ultimate cost of the distribution in this case, would tend to be more expensive than in the former method.

The welder outlets themselves, whether for mobile equipment or electrode loads, should be readily accessible and are therefore best not located in the service subway, even if one is available, although the remote control equipment sometimes used may be installed therein.

As with all other outlets, it should not be possible for the welder plug to be inserted or withdrawn on load, and this contingency is circumvented by the use of electrical and mechanical interlocks. The electrically interlocked socket is so arranged that the insertion or withdrawal of the plug top closes or opens a contactor, by means of auxiliary pins which make circuit only after the main current carrying pins are in contact with the socket, and open the circuit before the main pins are withdrawn. These contactors may be located in the service sub-way.

The mechanically interlocked switch socket comprises a switch and socket assembly in one housing so arranged that the socket can neither be inserted nor withdrawn with the switch in the "on" position.

A problem that arises with the use of portable welders is the avoidance of the risk of stray earth currents.

Unless the earth electrode is properly made on to the work—and in many cases it is possible to weld without the earth electrode connected at all—the return earth currents are liable to

Portable Welder Unit

travel back to the transformer by various routes, sometimes very much to the detriment of the conductors carrying them fortuitously. It has not been unknown for earth continuity conductors to burn out when through the failure of the welding return circuit, the earth currents have been by-passed to them.

It is important therefore, that the earthing arrangements for the welding equipment be as foolproof as possible.

The permanent installation of a heavy copper tape, solidly connected to the earth-pins of all welder socket outlets and with metal frameworks in the vicinity, and to the main earth point of the installation, is a safeguard.

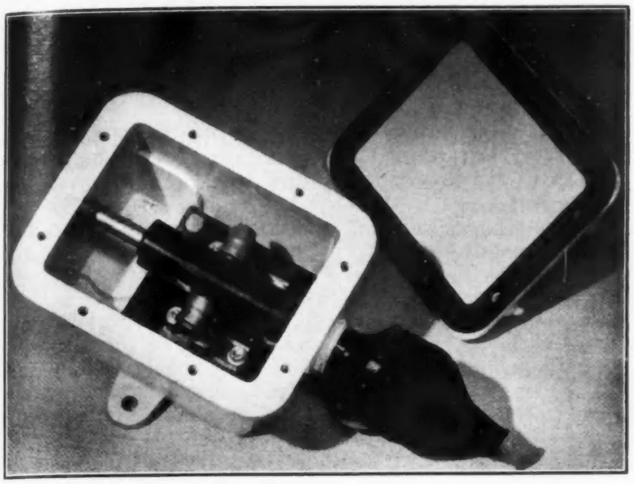
A low power factor is an inherent feature of alternating current welding, and with the use of a number of mobile welding units, correction is perhaps best applied at the main intake position. This means that the size of all conductors and current carrying parts of the welding installation have to be computed with regard to this low power factor, and are thus larger than would be necessary, if the power factor correction was applied at the point of load.

Welding circuits should be kept distinct from other circuits as far as possible, and should not be mixed with other services.

Low Voltage Outlets

Portable electrical tools, lighting fittings, and handlamps and similar apparatus constitute one of the biggest risks to personnel,

Modern Dry Docks—continued



Wear Connection Box—can be made as single or double socket ways.

in any industrial installation, if not properly maintained.

In a dry dock use is made of compressed air to a large extent, but there are situations in which electrically driven appliances must of necessity be used.

It is recommended under the Factory Acts that low voltage appliances be used for this purpose, and for that reason low voltage socket outlets are desirable.

The outlets should again be interlocked and are normally of 15 ampere rating.

The supply, in an alternating current installation, is derived from a transformer with the secondary wound for 110 volts, with the middle point earthed. The maximum voltage to earth is thus 55 volts. This is considered to be intrinsically safe.

The location of these outlets should be arranged so that the length of extension leads connected thereto for working purposes are kept to the minimum.

The use of travelling cradles running on tracks let into the dockside may be encountered. To avoid any possible damage to leads that may otherwise trail from high level to the basin level when such cradles form part of the dock installation, electrical outlets may well be needed at the bilge altar or keel block line. With constant sequence of immersion and exposure these sockets have to be very carefully designed for the onerous duty.

(To be continued)

National Dock Labour Board

Annual Report for 1957

After stating how the labour force has been maintained and used during the year 1957, this Report, which was submitted to the Minister of Labour and National Service on May 21st last, refers to reductions in the levy stabilisation fund made during the last two years and warns that, if these inroads continue, then there will have to be a further review of percentage payments.

The Scheme

In its opening paragraphs, the Report mentions the observations made on the recommendations contained in the Devlin Report. In making these observations, the Board recalled " the amendments to the Scheme which it had recommended to the National Joint Council for the Port Transport Industry in April, 1953, designed to permit delegation of disciplinary functions and to remove obscurities in wording and intention. The Board, therefore, learned with considerable interest of the statement in the House of Commons on 18th December, that, having considered the observations of all bodies in the industry and discussed the main recommendations with representatives of the National Joint Council and the National Board, you had accepted the recommendation that the structure of the Scheme should remain unchanged, and had decided that the functions of the Board should not be extended. At the end of the year the Board was awaiting the discussions with officials of your Ministry and representatives of the industry on the minor amendments to which you had also referred. It might perhaps be stated that although these amendments are minor in relation to the fundamental constitutional points with which the Committee has dealt, a number of them, and particularly those dealing with the disciplinary clauses of the Scheme, are by no means unimportant to members of Local Boards and others concerned with the day to day administration. Reference has been made in previous Reports to the heavy inroads which the requirements of the present Scheme make upon the time of members of Local Boards, and with the passing of the years there have been few signs of their burdens being lightened. It is, therefore, some consolation to be able to record that the administration of the Scheme has not been seriously challenged in 1957."

Labour Force

The first point made under this heading is that the association between the total volume of sea-borne trade and the labour required to handle an unspecified portion of it in the ports coming under the Dock Labour Scheme is so tenuous as to make any deductions from it highly dangerous, if not actually unwarrantable. During the early weeks of the year activity continued to be artificially stimulated by bunching in the arrival of vessels following the closing of the Suez Canal, and employment showed a corresponding improvement from the level prevailing in the summer of 1956. Thereafter, the subsequent demands for labour were subject to the sharp fluctuations which are characteristic of the industry, but over 1957 as a whole, employment on the docks fell by 2%, thus continuing the slowly downward trend of the previous year.

At its first half-yearly review of sanctioned strength in May, 1957, the National Board was of the opinion that labour requirements would not vary significantly before the second half-yearly review gave the opportunity for further detailed consideration of prospects, but that mild optimism was possibly justified for the last quarter of the year. At the same time, however, it was apparent that the reduction in registers which had taken place since early 1956 had not matched the fall in employment. Local Boards were therefore exhorted to continue the policy of accepting wastages without automatic replacement, but the majority were left with some scope to meet special circumstances.

The second half-yearly review was held shortly after the Government had increased the Bank rate to 7% and introduced further measures intensifying credit restrictions; it was against this background, and in the absence of significant improvement in the final quarter of 1957, that the Board felt impelled to reduce the sanctioned strength of a number of areas, and to extend to new areas the standstill order on recruitment which had been introduced in a limited number of areas at the end of 1956. Although the principal decisions on sanctioned strengths were taken as is customary at the half-yearly reviews, the trade prospects on each occasion were more than usually obscure. Consequently, the registers were also reviewed at regular monthly intervals; this procedure enabled particular attention to be given to the special and abnormal growth of labour demand in the Middlesbrough area, and to the needs of ports where seasonal traffics appeared likely to create short-term peaks. Thus, in the course of the year the sanctioned strength was reduced from 78,538 to 76,500, and the actual labour force was reduced from 75,993 to 74,471.

Probationary, temporary and seasonal registers together reached a peak of only 2,399 men in 1957, compared with a maximum of 2,745 men in 1956. Nearly half the intake to main registers consisted of men who had already served in a probationary capacity; this source of recruitment was supplemented by promotions from temporary and seasonal registers. In the absence of a formal scheme of initial training, this further development from the position reached in the previous year is an encouraging

National Dock Labour Board—continued

indication of the growing extent to which those admitted to main registers have established their claim by previous practical experience in the industry.

The general level of employment and the corresponding contraction in the size of the labour force have been reflected in the number of weekly workers. The weekly average of the number registered in 1957 was 17,132, compared with 17,004 in 1956, so that the rate of increase has been very much less than that experienced in previous years.

The average age of workers on the main register increased to 46.1 years, the corresponding age at July 1956 being 45.6 years. This difference arises from restriction on recruitment.

Non-Registered Labour

In view of the present strike of dock workers in London (May/June 1958), the paragraph dealing with the employment of non-registered labour (one of the controversial issues of the strike) is of particular interest. [It is pertinent to quote here Clause 10 (3) (a) of the Dock Workers' (Regulations of Employment) Scheme 1947, which states . . " where the local board is satisfied that (i) dock work is urgently required to be done and (ii) it is not reasonably practicable to obtain a registered dock worker for that work, the local board may, subject to any limitations imposed by the National Board, allocate to a registered employer a person who is not a registered dock worker.]

The Report states that " the extent to which non-registered labour is engaged to assist in meeting intermittent labour shorttages is, of course, dependent partly on the general employment position in the locality and partly on the extent of the fluctuation in the demand for dock labour. In the event, there was a slight increase in the assistance obtained from this source as compared with the previous year."

Man/days lost by disputes during 1957 totalled 94,077, a figure which " does not compare unfavourably with most of the years since the Scheme's inception. The major part of the time lost during the year was due to support being given in London to the Covent Garden Market porters' strike; the effect of this was that for a period of ten days an average of 6,200 dock workers withheld their labour."

Training

The Board maintained its policy of training specialist workers, though with falling registers and a general slowing down of recruitment, the need for additional specialists was considerably less than in the two previous years. In total an expenditure of £4,632 was incurred to meet local needs in various ports, and in continuing the contribution to the training of apprentices for future registration as London lightermen. A total of 297 men undertook one or other form of specialist training, of whom 289 subsequently qualified.

National Agreements

Under an Agreement which came into effect from 20th May, 1957, the National Joint Council for the Port Transport Industry increased the daily wages of men on time rates by 1/6d. to 29/6d., payable on a half-daily basis, and provided for the minimum guarantee to piece-workers to be correspondingly increased; the Agreement also established an increase of 5.35% on existing gross piece-work rates and adjusted the travel time allowances payable under National Transfer Agreements.

The average weekly gross earnings of daily workers was £13 16s. 6d. in 1957 compared with £12 19s. 10d. in 1956.

Finance

After dealing with new premises (which included a pavilion and club house at the National sports ground in London) and welfare arrangements (medical services, first aid, rehabilitation, dock amenities, education and sports), the report gives details of the Board's income and expenditure. " There was very little difference," it is stated, " in the total yield of percentage payments for 1957 (£4,940,824) compared with the previous year (£4,938,320)—the reduction in revenue which might otherwise have resulted from the lower average employment having been almost exactly counter-balanced by the higher rates of pay." To cover the expenditure on welfare services, the Board made the usual appropriation to General Welfare Fund (at ½% on the wages of all dock workers, amounting to £251,625) from its total percentage income, leaving the total revenue credited to Management Fund (including receipts from investments and other sources) at £4,797,970.

Total operating costs for the year fell from £5,650,850 in 1956 to £5,558,082. This total included capital costs amounting to £266,865, welfare costs amounting to £232,941 and normal expenditure falling on Management Fund of £5,058,276. The Management expenditure was about £73,000 lower than the previous year, mainly because of the lower average of surplus labour resulting in a saving of about £120,000 in expenditure on attendance money, which was partly off-set by increased payments of make-up and by increases in holiday pay and other payments to workers at the higher rates of pay. In spite of generally rising costs, Administration and General Expenses only rose by about £23,000; there was, however, a compensating reduction in contributions to National Insurance arising from the declining register of daily workers.

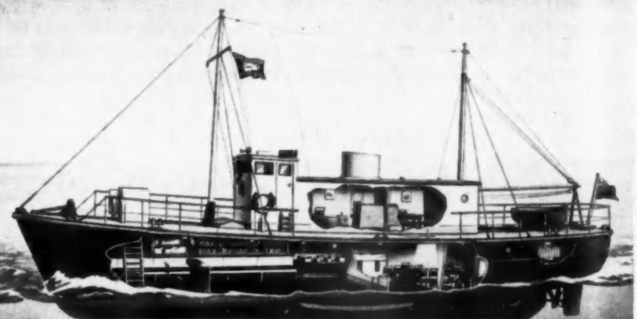
Levy Stabilisation

In 1955, the Board used a surplus on Management Fund of some £643,000 to build up its Levy Stabilisation Fund from £2,627,000 to £3,270,000. So as to avoid variations in the rates of percentage payments, appropriations in the reverse direction have been necessary in 1956 (£370,000) and in 1957 (£290,000). These inroads on Levy Stabilisation Fund reduced it to £2,610,000 which is approximately the point at which it stood in 1954, though the later reading is taken on a generally downward curve which, if continued unduly, will inevitably call for further review of the rates of percentage payments.

New Vessel for Missions to Seamen

The " John Ashley," a new floating Church and Recreation Room for the men of coasters and colliers in the Thames and Medway, was launched at the Hampton-on-Thames Boatyard of Messrs. John I. Thornycroft & Co. Ltd., on 19th May, 1958, by Mrs. Leopold Lonsdale, J.P., wife of the Chairman of The Missions to Seamen Finance Committee.

Speaking at the launching ceremony, the Rev. C. J. Brown, O.B.E., M.A., Superintendent of The Missions to Seamen, re-



Artist's impression of the new " John Ashley " showing internal accommodation.

ferred to the vision and enterprise of the Rev. Dr. John Ashley who founded the mission in 1837. Since then, the work of The Missions has been carried on all over the world and not least on the Thames in the converted Admiralty fishing boat which bears his name.

The new " John Ashley," which is 75-ft. in length, will replace this vessel and will provide accommodation for 60 seamen, being equipped to offer them in port religious services, a library, television and cinema shows. The boat was designed and built by John I. Thornycroft & Co. Ltd., and is fitted with two Thornycroft type RNR6 diesel marine engines each developing 90 b.h.p. at 1,600 r.p.m.

Shoreham Harbour Development

(Specially Contributed)

The official opening by H.R.H. the Duke of Edinburgh, on Tuesday, the 20th May, marked the completion of three years' work on the development of Shoreham Harbour, Sussex. The works, costing almost £3m. have been carried out for the Central Electricity Generating Board to permit the access of colliers of up to 4,500 D.W.T. to the new Brighton "B" Power Station, thereby effecting a substantial economy in fuel transport costs.

Briefly the works undertaken in the development comprised the following:—

(1) The construction of two new mass concrete breakwaters.
(2) The construction of a new lock.
(3) The construction of new lay-by Wharves, both in the outer harbour and in the non-tidal basin or Canal.
(4) Dredging of the entrance, outer harbour, and Canal.
(5) Provision of a turning basin at the eastern end of the Canal.

Development of the Port

Shoreham Harbour is situated at the mouth of the River Adur, which is in the centre of the Brighton-Worthing Bay on the Sussex coast. The point at which the river discharges into the sea was stabilised in 1820: previously the position of the river mouth varied over a distance of some four miles, first travelling eastwards, due to the formation of a long shingle spit, then returning westward as the river broke through the spit at a time of heavy discharge.

By 1850 that part of the harbour between the present entrance at Kingston and the old entrance at Aldrington had so silted up as to make it useless for the greater part of its length. Subsequently a lock was built on the site of the existing dry dock, and an artificial embankment constructed in order to form an area of impounded water, now known as the Canal. In 1933 the Prince George Lock was constructed which enabled vessels of up to 1,500 tons deadweight to enter the Canal.

The harbour now extends over a distance of nearly five miles and is divided into three sections, the Western Arm formed by the lower reaches of the River Adur to the West of the harbour entrance, the Eastern Arm between the entrance and the locks, and the Canal between the locks and Aldrington Basin at Hove. Wharves have been constructed on both the North and South Banks of the Eastern arm from which entrance to the Canal is obtained through the locks. Wharves are also constructed on both sides of the Canal which is a mile and three-quarters long, and is navigable over its full length.

The shingle spit between the Canal and the Sea forms the site of a large gas works and two power stations, Brighton "A" station commissioned in 1906, and the important Brighton "B" station commissioned in 1954.

General Description of New Works

The old harbour entrance was only 170-ft. wide between the timber and concrete piers, the positions of which were determined in about 1879. The depth of water at the entrance was 19-ft. at M.H.W.N. and this was also the normal depth of water in the Canal. Vessels of up to 200-ft. in length only could pass the lock at the entrance to the Canal, and the maximum size of vessels trading into Shoreham was 1,500 tons deadweight.

Aerial view of Shoreham Harbour showing the new breakwaters and locks.

A completely new harbour entrance has been provided in a position some 500-ft. further seaward than the former entrance. The entrance to the port is between two new mass concrete breakwaters, the western one 800-ft. long and the eastern breakwater about 1,200-ft. long, the width between their seaward extremities being 420-ft. The former East Pier has been demolished and a new mass concrete inner breakwater has been constructed much further to the eastward.

Spending beaches have been provided between the West Breakwater and Pier and between the East Breakwater and Pier with the object of reducing wave action in the inner harbour.

The apex and the western wing of the old Middle Pier have been demolished and rebuilt on a new line. The pierhead is now 70-ft. north of its old position and provides greater manoeuvring space in this part of the harbour and an easy approach to the Western Arm channel. The dredged depth at the harbour entrance is now 22-ft. 6-in. at M.H.W.N., as is the depth of the 300-ft. wide channel leading to the new lock.

The new lock, named Prince Philip Lock, constructed south of and adjacent to, the Prince George Lock, has a length of 372-ft. and a width of 57-ft., with a depth of 22-ft. 6-in. over the cill at M.H.W.N. Substantial lead-in jetties have been constructed at each end of the lock to provide for the easy approach of vessels into the lock. Steel mitre lock gates are provided which together with the lock sluices are operated by electro-hydraulic equipment.

New inner and outer lay-by wharves of steel sheet piling have been provided at both ends of the lock on the south side, and vessels waiting to enter the locks can, when necessary, lie alongside these wharves.

The depth of water in the Canal has been increased to 24-ft. and a new Turning Basin has been provided at the east end of Brighton "B" Coal Wharf measuring 470-ft. by 450-ft. An enlarged channel with a minimum width of 165-ft. has been dredged between the lock and the Turning Basin.

The new works of particular interest are the breakwaters and the lock, and the design and construction aspects of these are dealt with more fully below.

Design and Construction of Breakwaters

The maximum fetch in the storm zone is about 100 miles, from which it was estimated that waves up to 15-ft. high can be

Shoreham Harbour Development—continued

generated. Records indicate that waves at least 13-ft. in height have been experienced in the English Channel, and this was confirmed by observations at Shoreham. Wave length is of the order of 150-ft. with a period of about 6—8 seconds; storms most affecting the harbour being experienced from the quarter S.W.—S.E. Tidal range at Shoreham is 18-ft. on mean spring tides and 10-ft. an mean neap.

The maximum depth of water at the ends of the breakwaters is 30-ft. at maximum high water, and it was therefore judged improbable that the tallest positions of the breakwaters would be subject to breaking waves at High Water. These could only be expected further inshore.

The breakwaters at their maximum section were therefore designed for clapotis waves in accordance with the recommendations of the 1935 Congress of the Permanent International Association of Navigation Congresses at Brussels.

The type of breakwater construction adopted was largely dictated by the availability of materials. The armoured rubble mound form of construction was ruled out, as durable rock in larges sizes and adequate quantities was not available within economic hauling distance. However, shingle up to 2-in. gauge, and moderately well graded sand were obtainable on site and suggested some form of concrete construction. The works were of insufficient magnitude to justify the use of the heavy block placing cranes, so it was decided to build the breakwaters of mass concrete placed between the two rows of permanent steel sheet piling.

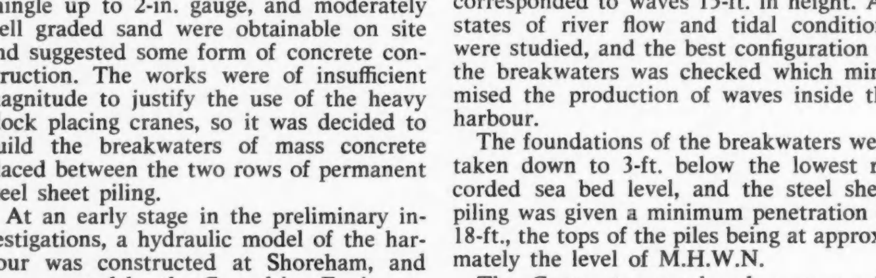
At an early stage in the preliminary investigations, a hydraulic model of the harbour was constructed at Shoreham, and was operated by the Consulting Engineers. The model was built to a natural scale of

General view from west of lock and lead-in jetties, shortly before flooding the cofferdam.

1 : 120 and had a fixed bed. The maximum size of waves reproduced in the model corresponded to waves 15-ft. in height. All states of river flow and tidal conditions were studied, and the best configuration of the breakwaters was checked which minimised the production of waves inside the harbour.

The foundations of the breakwaters were taken down to 3-ft. below the lowest recorded sea bed level, and the steel sheet piling was given a minimum penetration of 18-ft., the tops of the piles being at approximately the level of M.H.W.N.

The Contractor employed a very substantial piling guide frame, running on the



East Breakwater in course of construction in mass concrete.

tops of the previously driven side sheet piling and cantilevering forward for driving the next section of piles. When each section of piles had been driven, the foundation was then excavated by a crane mounted on the guide frame. All concrete was mixed at a central batching plant and pumped to the scene of operations. The shingle aggregate won by the Contractor from the harbour bed by a reclamation unit, made the use of pumps particularly suitable for concrete placing.

The upper lifts of concrete on the breakwaters were cast inside conventional shutters carried from the piling guide frame. For part of the work, pulverised fuel ash was added to the concrete replacing a proportion of the cement content. It was found that, as a result, a significant reduction of the maximum concrete temperature and a somewhat flatter cooling gradient were achieved. Difficulties associated with the introduction of the fuel ash into the central batching plant militated against its more general use.

Each breakwater is surmounted by a parapet wall, keyed to the mass of the breakwater. These walls were cast in lengths separated by wide gaps which were concreted at a later stage.

Design and Construction of the Lock

The original design of the lock envisaged an orthodox structure with mass concrete floor and gravity type walls.

The design of the filling and emptying culverts followed normal practice except that hydraulic jump chambers were provided to increase the discharge. Small scale-model experiments were conducted to establish the best form of these chambers. The experiments also provided information on the extent of the aprons required to prevent scour in front of the gates.

Borehole information indicated a layer

Shoreham Harbour Development—continued

of gravel at the level of the foundations which, it was thought, would provide a suitable surface for concreting operations. Below the gravel was solid chalk in which artesian water was present and it was anticipated that relieve wells would be adequate to counter this difficulty.

The plan area of the lock was surrounded with a steel sheet piling, driven into the chalk and the area divided into three bays by two transverse diaphragms. This arrangement it was considered, would lead to some reduction in the hydrostatic pressure under the floor and allowances were made accordingly in the design.

On excavating in trench for the north well foundation, such discouraging conditions were met with that it became evident that it would be both difficult and costly to retain the original design. The sub-strata were such as to invalidate the original design criteria, and after tests a pile foundation was adopted.

The Contractor incorporated positions of the western lead-in jetties in the cofferdam and supplemented these with a shingle filled double-skin dam across the western entrance to the lock. At the eastern end, a single line of piling was driven, with a bank of filling retained on the inside to ensure stability and water-tightness.

The excavation for the walls was carried out in trench, and the walls were concreted in seven lifts, in bays up to 40-ft. long. When the dumpling was removed, heavy temporary struts between the walls were left in place until the floor had been concreted.

Lead-in Jetties and Lock Gates

A mass concrete lead-in wall was provided at the south-east corner of the lock, but otherwise the lead-in jetties are of steel sheet pile construction.

The lock gates which were manufactured in the makers yard and towed to Shoreham are of double skin buoyant mitre design of all welded construction, each leaf having eleven horizontal plate decks and two vertical diaphragms. All decks are of mild steel plate fitted directly between the skin plates and the heel and mitre-post steelwork. Cast steel top and bottom gudgeons are used and a tool steel pad provides the upper pivoting face at the bottom pintle. The heel-post, mitre post and clapping sill are of greenheart timber.

The gates and main culvert sluices are moved and controlled by electro-hydraulic means, there being a separate control house with pumps and motors for each side of the lock. The control lever for each gate or valve is arranged adjacent to the leaf or valve it controls.

Emergency operation of the gates and sluices by hand pumps is provided for, in the event of a power failure, and in addition two hand operated penstocks are arranged at each end of the lock.

The whole of the new works were commissioned and financed by the Central Electricity Generating Board, but eventual possession will be vested in the Shoreham Harbour Trustees.

Design and supervision of the works was the responsibility of Sir William Halcrow and Partners, Consulting Engineers.

The main civil engineering work under the contract was carried out by Peter Lind and Co. Ltd., the dredging sub-contractor being the Britannia Dredging Works Co. Ltd., the Lock Gates were supplied by Head Wrighton & Co. Ltd., and electro hydraulic equipment by Messrs. Keelavite Ltd.

Marine Surveying in Harbour Areas

Some Important Aspects

By Commander D. H. MACMILLAN, M.B.E., R.N.R., F.R.I.C.S.

The interesting article by Mr. McLean, in the February issue of "The Dock and Harbour Authority," on his work in the Port of Newcastle, and the letter of comment by Cmdr. Margrett, in the March correspondence, are of great interest to surveyors generally, and it is felt that the following remarks, involving some criticism as well as comment, may be of value to the Journal's wide circle of technical readers.

They are intended to be constructive:—

(a) Regarding subtense methods for determining the location of soundings off dock walls, etc., it is confirmed that the manageable length of a portable board is about 16-ft.

On the other hand, if a sextant is used in conjunction with the subtense target it is unreasonable to assume that angle settings afloat are in practice closer than ± 1 minute of arc, that index error is always within that limit, or that the personal error in observing the co-incidence of the subtense points in a moving launch will fall within closer limits.

The possible combined error may easily, therefore, be ± 3 minutes of arc, and it is essential to plan methods of survey to reduce plottable errors to reasonable limits of accuracy.

As an error of ± 1 minute of arc in using a 16-ft. subtense would give errors in a position of ± 5 and ± 13-ft. at distances of 500 and 880-ft. respectively, we can assume treble these figures in practice.

This does not include the further complication of parallax values, which would in any case be swallowed up in the greater possible aggregate error described above.

My experience has satisfied me that subtense methods with boards of the dimensions we are considering should not be employed at offshore distances exceeding 600-ft., if reasonable accuracy in plotting on the usual harbour scales is to be expected, and I emphasise the need for reasonable limits of accuracy at the extreme distances measured, as well as the closer.

If the distances exceeding this value are attempted horizontal check angles should be observed as subtenses on the carefully measured base lying between the front transit marks on either side of the transit being used, **providing the launch is located accurately on steering marks separated by not less than** 1/12 the maximum offshore distance on any given section.

If such steering marks cannot be established, say, on one side of a river such as Tyne, an 180° optical prism can be used to maintain transit by targets on the opposite bank (the manual shifts being controlled by portable R/T) or a distant chimney or spire which will enable lines to be run with little divergence from parallelism.

Otherwise the orthodox three-point fix is essential to give the precision expected by survey standards, and certainly required in mid-river where a barge, or other object, sunk with some air cavity, might be moved by tidal streams.

(b) The best solution for subtense work at distances of up to 400—500-ft. is a small fixed-angle prism giving a constant and accurate refraction of, say, 1° 30′. The board can be calibrated to give 10—12-ft. intervals capable of accurate interpolation, there is no parallax problem, no pre-setting errors are involved, and it can be stowed in the Surveyor's pocket.

The writer has a small station keeper, used in World War One, combining two prisms, using the 3° prism for reasonably accurate distances up to 300-ft., and the 1½° alternative for those up to 600-ft. It is again emphasised that steering transit marks should have a minimum separation of 1/12 the maximum distance on offshore sections.

(c) In dealing with possible errors in echo-sounding due to the polar beam of the magneto-striction echo-sounding oscillators, now in use in large-scale work (e.g. those coupled with the Kelvin & Hughes M.S.26A recording device) I have confirmed entirely the comments made by Cmdr. Margrett in his letter in the March issue of "The Dock and Harbour Authority."

In my earlier book, "Precision Echo-Sounding," I used a very rough practical figure of 15° for the suspected apex angle of the approximate cone of the polar beam for locating side obstructions.

An accurate plot of the periphery of the polar beam does not substantiate this approximation, which is excessive. I

Marine Surveying in Harbour Areas—continued

have placed a survey launch of 12½-ft. beam, equipped with inboard oscillators (at 3-ft. separation) in side contact with the amidships section of the liner "Queen Mary," drawing 38-ft., without recording and side shadow whatsoever.

I am fairly satisfied that with a reasonable sensitivity control on the recorder, the displacement error of 5-ft. (approx.) from the position immediately below the oscillator is a maximum, **providing always that a bar-check** is taken near the required depth before and after the examination of dredged areas and slopes, to ensure that such sensitivity control is not recording a fictitious depth.

It is to be emphasised that no safe contribution to accuracy can be made by altering the pre-set decay and voltage controls, and that the **sensitivity** adjustment must, in all cases, be controlled by reflector bar-check indications with a target at least 8-in. wide suspended by carefully calibrated depth wires, to ensure that the **real** bottom has not been eliminated by undue reduction.

If this is not done before and after the work, and instrumental speed is not carefully checked, serious errors may arise which could otherwise be avoided, and kept within acceptable survey limits. It is very easy to determine the nature of the bottom by lowering the reflector bar into recorded coincidence with the bottom, and noting the limits of further penetration by carefully easing down until the weight comes off the lines. I have never yet noted an instance where the top of the bed, however soft, was not accurately indicated.

(d) I think there is room for considering the need both for actually recording silt in suspension for research project, as well as eliminating "cloudy" recording between waterline and sea bed.

In using 15 k.c. oscillators I have never been seriously embarrassed, but those using 40—50 k.c. sets have reported that they could not see bottom in Eastern waters during the monsoon period, e.g. in Bombay Harbour.

I think there is room for constructive research on the effect of increasing frequency and power for the several following purposes:—

(i) The elimination of "clouding" during survey.
(ii) The optimum recording of silt in European waters for research purposes.
(iii) The penetration of soft bed layering over hard clay and rock.

I would conclude by strongly advising every hydrographic surveyor to use the bar-check technique as an absolute criterion for his confidence in accurate depth recording, and ensuring that electrical sensitivity control has not "robbed the bottom." The record of such a bar-check should show on all his final records as evidence of the integrity of his work.

The points raised by Mr. McLean, and the comments by Cmdr. Margrett are of the greatest importance in clearing the now well-established principles of echo-sounding in harbours from the many difficulties and doubts with which it has been beset by uninstructed "rough and ready" applications, now, fortunately, clarified after closer investigation.

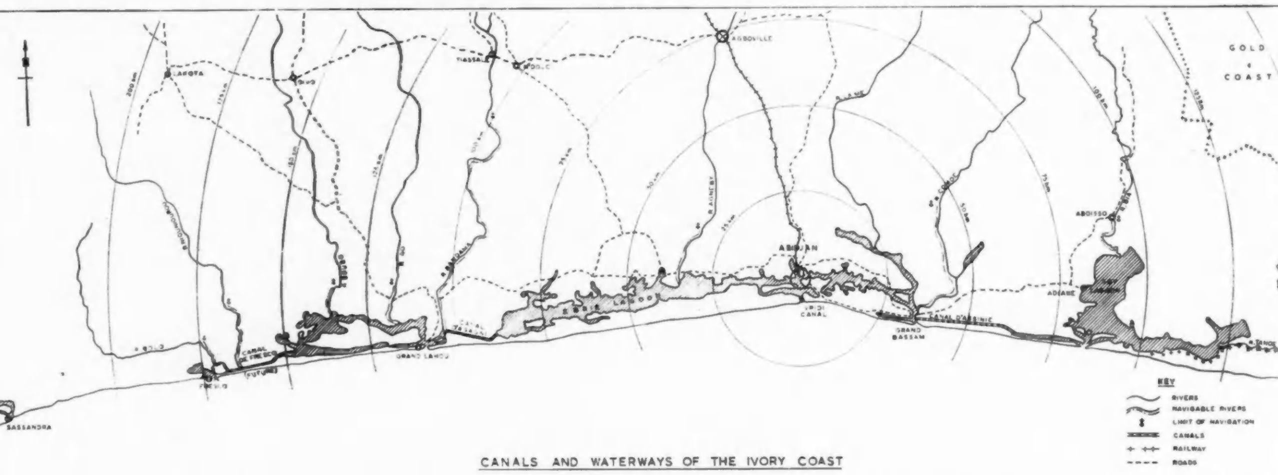
The Port of Abidjan

Supplementary Note on Littoral Movement of Sand

The leading article of the March, 1958 issue of this Journal described the design, construction and development of the Port of Abidjan on the Ivory Coast, and one of our Editorial Comments expressed the hope that it would be possible to add some further information as to how far the constricted orifice effect of the mouth of the new Vridi Canal has served to counteract the deposition of sea-borne sand, and whether there was any noticeable alteration in the previous regime.

Readers will perhaps recall that behind the open sandy beach extending along most of the Ivory Coast, a belt of deep-water lagoons extends for a distance of about 200 miles parallel to the coastline. At two or three places, water courses with coastal bars carry the flow from rivers and the lagoons to the sea, but no outflow exists near Abidjan. The nearest inlet is at Grand Bassam, and here the sea approach is obstructed by the Barre Costa. In order to exploit the hinterland resources, it was therefore decided to construct a canal through the coastal strip to the township of Abidjan behind, and to develop the port on the North side of the Ebrié Lagoon. A plan of the lagoon areas, which amplifies the large-scale plan reproduced on page 373 of our March, 1958 issue, clearly demonstrates the value of the new canal at Vridi. The very large size of the lagoon system is brought out, and the locations of the Assinie Canal and the projected Fresco Canal are now shown in relation to the Port of Abidjan. From this it will be appreciated that the opening of the Assinie and Fresco canals could have little, if any, effect upon the regime of the Vridi canal, having regard to the small cross-section of the former (70-ft. wide by 9-ft. depth), and their distance from the canal at Vridi.

Offshore from the Ivory Coast, conditions are dominated by the Guinea Current which gives rise to an Easterly set between February and November of about 2 knots, with an increase of up to three knots from May to July. However, between November and January a Westerly set of up to 1 knot may also occur. The tidal range at Vridi varies between 3-ft. at neaps and 4½-ft. at spring tides. The off-shore current is strongest about 12 miles from the coast, but is nevertheless appreciable right inshore. The effect of all these factors is to produce a West to East littoral drift



CANALS AND WATERWAYS OF THE IVORY COAST

Port of Abidjan—continued

of sand estimated at about one million tons per annum. It is therefore surprising to receive a report from Abidjan informing us that a new sand beach is forming to the **West** of the West Breakwater which was built to protect the entrance to the canal. The formation of this beach became apparent last July, and is accompanied by significant erosion of the beach to the East of the canal. It is believed that, as at Lagos, the explanation of this anomaly lies in the local topography of the beach, which forms a promontory and induces a significant eddying effect.

The normal width of the Vridi Canal is about 1,200-ft. with a central channel about 49-ft. deep and 656-ft. wide. The cross section is designed to minimise flow resistance and to provide a large reservoir for the sluicing current set up on the ebbtide. The mouth of the canal at the seaward end has a " raised sill " with a water depth of about 39-ft., and at this point the width is restricted to 820-ft. Further information has now been obtained as to the effectiveness of the design of this channel, and it can be stated that up to the present, the scouring effect of the constricted mouth of the canal has been perfectly effective in preventing the formation of a sand bar immediately seawards. However, the build-up of sand outside the west breakwater, referred to above, is so recent that its possible effect on sand bar formation and on siltation within the canal, cannot yet be judged.

In conclusion, it should be mentioned that the siting of the Vridi Canal was studied in conjunction with a most unusual geological rift in the African Continental Shelf, which occurs immediately offshore. There exists, to within one mile of the coastline, a submarine chasm which is designated on Admiralty Charts as " The Bottomless Pit." This chasm, about 20 square miles in area, plunges from an ocean bed level of generally about 30 fm., to a floor level of between 135 and 200 fm. The mouth of the Vridi Canal is located immediately opposite the point of closest approach of the " Bottomless Pit " to the coastline, and it is hoped that the effect of the breakwaters will be to lead littoral sand drift into very deep water rather than to cause the formation of a sand bar at the canal mouth.

Manufacturers' Announcements

Cargo-Tanker Motor Vessel for the Caribbean

Constructed on the general lines of a war-time landing craft the twin-screw motor vessel " Bahamas Developer " has now been delivered from the Dorset Lake Shipyard at Hamworthy, Poole, to her owners, Messrs. Symonette Shipyards Limited, of Nassau, N.P., Bahamas.

Part cargo vessel and part tanker, the vessel will go into service between Nassau and the outer islands of New Providence, and her design has been influenced by the lack of port facilities at these places and the necessity of beaching all supplies needed for development projects. Such machinery as bulldozers and cranes together with constructional materials and equipment will be carried as deck cargo and off-loaded from the ramp in the bows, while the forward holds accommodate tanks for the bulk transportation of fresh water, fuel oil and bottled gas required by contractors working on development sites.

The general dimensions of the " Bahamas Developer " are: length overall, 125-ft.; beam, 32-ft.; depth, 7-ft. 6-in.; tonnage, 280 gross.

The construction is of all-welded steel with scantlings of ⅜-in. and ½-in. plate on 7-in. by 7/16th-in. long longitudinal flat bar frames with ¼-in. plate superstructure, and the new vessel will be worked by a crew of nine.

Main and auxiliary machinery in the engine-room aft has been supplied by Lister Blackstone Marine Ltd. The main engines comprise a handed pair of Lister-Blackstone six-cylinder pressure-charged engines each developing 450 b.h.p. at 750 r.p.m., driving three-bladed manganese bronze propellers of 39-in. diameter and 25-in. pitch through co-axial type gearboxes.

The propellers run at engine speeds, each engine being fitted with a Blackstone patented flexible nodal damper coupling between flywheel and reverse gearbox giving complete absence of criticals throughout the speed range. Because of the operational requirements of the vessel, the propellers are house in tunnels. Sterntubes and propellers were supplied by Messrs. F. Bamford Limited, of Stockport, Cheshire.

There are three auxiliary units: a 24 h.p. Lister engine directly coupled to a 15 kilowatt generator; a second engine with raised overhead starting directly coupled to a 15 kw. generator and clutch-coupled from the generator shaft extension to a Hamworthy general service pump having a capacity of 30 tons/hour against a total head of 40-ft. The forward end of this engine is clutch-coupled to a two-stage Hamworthy compressor delivering 7½ c.f.m. at 350 lb. sq. in. The third auxiliary is a Lister 3½ h.p. air-cooled diesel engine directly coupled to a 1½ kw. 24/32 volt shunt wound battery charging generator.

The wheelhouse is fitted with normal navigational aids and telegraph to the engine-room. Aft of the wheelhouse are the Master's quarters, while crews quarters, galley, mess-room and wash-room are below at main deck level. " Bahamas Developer " is fitted out to Ministry of Transport requirements, a 16-ft. lifeboat being carried in davits aft, starboard of the wheelhouse, together with two ten-man life rafts.

Cargo-tanker motor vessel " Bahamas Developer."

Submarine Power Cable for New Zealand

In March, 1956, the British Insulated Callender's Cables Group were instructed to investigate the practicability of linking the rich electric power resources of New Zealand's South Island with the supply network of the industrial North Island. This investigation resulted in an announcement last April by Mr. H. Watt, the Minister in Charge of the New Zealand State Hydro Electric Department, that the Group were to lay, test and recover a trial length of cable in order to provide data for the ultimate installation of a submarine power cable across Cook Strait.

The trial cable, half a mile in length and with an overall diameter of 5-in., is of the single-core pre-impregnated high-pressure gas-filled type, and is to operate at 250,000 volts D.C. It has a hollow copper conductor, is paper insulated and lead sheathed, and is suitably reinforced with steel tapes and steel wire armouring to withstand the particular conditions of the sea bed under Cook Strait. It was not of sufficient length to warrant transport by a cable-ship as would be the case for the continuous length required for the complete crossing. It was therefore coiled on a giant drum 15-ft. 8-in. in diameter and 7-ft. 6-in. across, weighing, with the cable, about 45 tons.

Under the supervision of engineers from the Group, the trial length is being laid by the New Zealand Post and Telegraph Department's cable-ship H.M.T.S. "Matai" seawards from Oteranga Bay, which is on the North Island shore of Cook Strait south of Cape Terawhiti. After the ends have been sealed, the cable will be anchored and allowed to remain on the seabed for as long as possible.

For the full-length cable the projected Cook Strait crossing route is a distance of some 25 miles, with a maximum depth of 150 fathoms.

Manufacturers' Announcements—continued

Tweddell Compression Fenders

In the last few months, attention has been drawn to the use of Tweddell Compression Fenders for the docking of the large aircraft carriers in Portsmouth Naval Dockyard, where it has been stated that they have definitely prevented damage to both jetties and ships.

Each fender consists of an interlocked framework of timber containing compound rubber tubes, each of which can absorb a definite amount of pressure. It is claimed that these fenders do exactly the same work as gravity and beam fendering, and are capable of absorbing kinetic energy in excess of the amounts developed by the largest vessels afloat. They are extremely durable and, compared with the same types of fendering, their price is low.

Apart from their adoption by the Admiralty, Tweddell fenders are in use at Southampton, Dublin and Casablanca. Further information regarding them may be obtained from World Fenders Ltd., 26 Market Buildings, Swaythling, Southampton, or from Dock Services Ltd., 2 and 4 St. Mary Axe, London, E.C.3.

Cathodic Protection of Ships

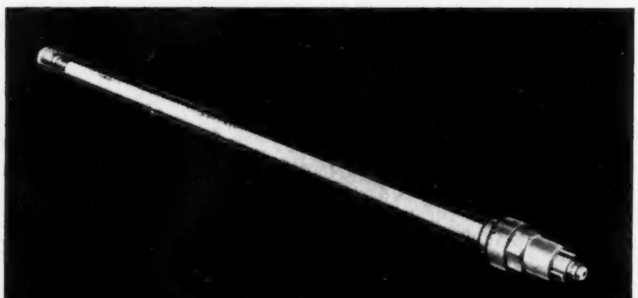
Messrs. F. A. Hughes & Co., Ltd., London, lately announced that they have now fitted their cathodic protection schemes to the under-water hulls of over 130 oceangoing ships, and new orders indicate the success that their method has achieved in service.

Owners appreciate that no delay is involved in providing a ship with this protection against corrosion, as the scheme is fitted well within the routine drydocking. Anodes are mounted at the turn of the bilge and are designed to fair into the underwater form, eliminating any practical interference with the vessel's speed. This negligible effect on speed is emphasised by the findings of a prominent research body whose calculations show that the speed of a typical vessel of 25,000 t.d.w. is influenced by as little as 1/6%. When the anodes are half consumed, this value reduces to 1/18%. Such figures are the more impressive when considered in conjunction with the 3%-4% reduction in speed which may be expected with only slight roughness of the hull due to corrosion.

Submersible Fluorescent Light Fitting

A new single-lamp 5-ft. submersible fluorescent fitting has recently been developed for the lighting of graving dock basins and similar situations. Made principally of gunmetal and "Perspex," the submersible fitting withstands corrosive elements normally found in fresh and salt water.

A Mazda 5-ft. 80-watt tubular fluorescent lamp is enclosed in a "Perspex" cylinder $\frac{1}{4}$-in. thick and $2\frac{1}{2}$-in. in diameter. This cylinder is hermetically sealed at one end and at the other it is cemented by "Araldite" epoxy resin into a gunmetal ring which is secured to a bell-shaped gunmetal casting, housing a lampholder and an "Instant Start" filament heating transformer. Other auxiliary gear is mounted remotely from the fitting. Cable entry is via the gunmetal casting, a twin lead being taken up inside the tube to the remote lampholder.



Tubular lamp fitting.

Re-lamping may be carried out by unfastening a locking ring which secures the "Perspex" assembly to the metal end casting. The fitting is supplied with a length of 3-core butyl rubber flexible cable sealed into the fitting by a watertight gland.

This submersible fluorescent light fitting is produced by A.E.I. Lamp and Lighting Co., Ltd., Leicester.

Motor Tug for Service in the River Thames

The Thames Tug and Lighterage Co., Ltd., have recently completed a steel motor tug of heavy scantlings for their own lighterage business on the River Thames. The vessel has an overall length of 47-ft. 6-in., breadth of 13-ft. 6-in. and a draught of 5-ft. 6-in. Named "Blackboys," the tug was constructed in the company's Brentford Yard and will shortly go into service.

The hull form is on orthodox round bilge lines with a raked stem, the bulwarks being set well back, and maximum deck space has been provided. The general arrangement from the bows aft comprises a fore peak, engine room, steering well, a cabin and after peak store. She is of partly welded and partly riveted construction, the riveting, in the main, having been carried out on the frame and beams, while the fashion plate type of stem is of $\frac{1}{2}$-in. thick mild steel plate which is stiffened with $\frac{1}{2}$-in. diaphragm plate welded to the bow plating.

Steel motor tug "Blackboys."

The tug is powered by a Thornycroft 6-cylinder marine diesel engine with a maximum 3/1 reduction gear, derated to give a continuous output of 100 b.h.p. at 1,500 r.p.m., being fresh water cooled with an exchanger and a keel cooler. Mounted on the fore end of the engine is a salvage and general service pump of $1\frac{1}{4}$-in. bore. Fuel is supplied by two tanks with a total capacity of two tons, which are fitted one on each side of the engine room.

Messrs. Goodyear Tyre & Rubber Co. (Gt. Britain) Ltd., supplied the 12-in. diameter rubber fenders which have been moulded to shape and are fitted forward and aft of the vessel.

Electric light has been installed throughout and the tug is equipped with the "Pye" ship-to-shore radio telephone speaker, the receivers of which are fitted in the cabin within hand reach of the steering wheel. A telescopic mast has been fitted forward of the casing, and all deck fittings are of substantial design including four 6-in. diameter tubular bollards with well rounded tops and tow rope stop posts 3-in. in diameter. Three towing guards have been fitted over the aft cabin top.

On trials in Chelsea Reach an average speed of 8.9 knots was attained and a bollard pull of 31.5 cwt. at 1,300 r.p.m. was recorded. A turning circle to port was completed in 41 seconds and to starboard in 40 seconds, the time taken to stop from full ahead with the engine in reverse averaged approximately 19 seconds with and against the tide; astern manoeuvrability was most satisfactory on either helm.

The tug was completed in 16 months since the laying of the keel; she was designed by Mr. R. C. W. Courtney, A.M.I.N.A., of Courtney Hughes & Partners and will be used principally for towing a train of up to six barges, carrying general merchandise.

With reference to the article "St. Lawrence Ports and the Seaway," which appeared on p. 26 of the May issue of this Journal, Messrs. Lorraine-Escaut point out that the Senelle piling used at Wolfe's Cove, Quebec was produced at their works at Longwy, France and not at Longivy-Bas, as stated.